

# MARBLEHEAD HARBOR MASSACHUSETTS

## SURVEY (REVIEW OF REPORTS)



U.S. ARMY ENGINEER DIVISION, NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASS.  
OCTOBER 6, 1961

R-12/61

## SURVEY (REVIEW OF REPORTS)

### MARBLEHEAD HARBOR, MASSACHUSETTS

#### SYLLABUS

The Division Engineer finds that the protected anchorage area at Marblehead Harbor is insufficient for the fishing and recreational fleets, both present and prospective. He finds also that benefits to be obtained by the provision of sheltered anchorage for these fleets are sufficient to warrant Federal participation in harbor protection improvement. He recommends, therefore, that the existing project be modified. He considers the proper modification should be the construction of a stone breakwater, extending from Marblehead Neck Point 1,200 feet in a northwesterly direction. The estimated first cost of construction (1961) is \$2,400,000 for the breakwater, and \$2,000 for additional aids to navigation.

The project is recommended subject to the requirement that local interests contribute 27 percent of the construction cost, said contribution presently estimated at \$648,000. The net cost to the United States is estimated at \$1,752,000 for construction, \$9,000 for pre-authorization studies and \$2,000 for additional navigation aids, with \$7,500 additional annual maintenance for the project modification and \$130 additional annual maintenance for the navigation aids. The benefit-cost ratio is 1.5.

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U. S. ARMY ENGINEER DIVISION, NEW ENGLAND  
CORPS OF ENGINEERS  
424 Trapelo Road  
Waltham 54, Mass.

6 October 1961

NEDGW

SUBJECT: Survey (Review of Reports) Marblehead Harbor, Massachusetts

TO: Chief of Engineers, Department of the Army, Washington 25,  
D.C. ATTN: ENGCW-P

AUTHORITY

1. This report is submitted in compliance with the following resolution adopted 2 June 1949, by the Committee on Public Works of the House of Representatives:

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Marblehead Harbor, Massachusetts, submitted in House Document Numbered 85, Seventy-seventh Congress, First Session, with a view to determining if the existing project should be modified, and particularly as to the advisability of constructing a breakwater."

2. The report was assigned to the New England Division by 3rd indorsement of the Chief of Engineers dated 5 July 1949.

3. The report under review was submitted by the District Engineer, Boston, Massachusetts, on 13 February 1940. It recommended improvement of Marblehead Harbor to provide increased anchorage space by dredging to a depth of 20 feet at mean low water, an area of about 13 acres on the east side of the harbor, and by dredging to a depth of 9 feet at mean low water, an area of about 16 acres at the southwest end of the harbor.

PURPOSE AND EXTENT OF STUDY

4. Engineering and economic studies have been made to determine the need and economic justification of modifying the existing Federal navigation project, and particularly as to the advisability of constructing a breakwater in Marblehead Harbor. A detailed hydrographic survey was made to determine the most practicable location of a breakwater. Estimates of various possible breakwater layouts were also

made. A public hearing was held at Marblehead on 27 January 1958. Information presented at the hearing is described under "Improvement Desired". The information obtained from the public hearing has been further supplemented by recent field investigations and discussions with local interests. Available maps, past records, and other data pertaining to the harbor have been studied.

#### DESCRIPTION

5. Marblehead Harbor is a small, rectangular cove located in Massachusetts Bay about halfway between Cape Ann and Boston. It is about 14 miles northeast of Boston Harbor and 11 miles southwest of Gloucester Harbor.

6. The harbor, about 7,500 feet long and 2,000 feet wide, has a longitudinal axis lying in a northeast-southwest direction. The northwesterly shore of the harbor is formed by the mainland occupied by the town of Marblehead, while the opposite shore is formed by the projecting body of land known as Marblehead Neck. A causeway connecting Marblehead Neck with the mainland closes the harbor at its southwesterly end, leaving the northeast end exposed to the sea. Of the total harbor area of approximately 300 acres, depths of 6 feet, 12 feet, and 18 feet at mean low water are available over areas of 260, 200, and 160 acres, respectively. Shoaling in the harbor is negligible.

7. The mean and spring ranges of tide are 9.1 feet and 10.6 feet, respectively. Tidal currents are negligible. The harbor is well protected except from the northeast quadrant. Storms from that quarter often cause considerable damage within the harbor. The locality is shown on United States Coast and Geodetic Survey Charts 1207, 240, and 241 and on the map accompanying this report.

8. There are no bridges crossing any portion of the waterway under consideration in this report.

#### TRIBUTARY AREA

9. The town of Marblehead, with a population of 18,521 in 1960, is chiefly residential. In 1958, the assessed valuation was \$39,104,000. Industry is limited primarily to retail establishments which cater to the needs of the permanent as well as the large summer population attracted by yachting and other recreational activities for which the area is noted. Six boat yards, engaged in the construction, repair, storage and maintenance of boats, are located on the waterfront. There are 9 fishing companies deriving some support from the use of Marblehead Harbor. Important industrial centers are located

RECOMMENDED  
1200 FT. BREAKWATER

MARBLEHEAD HARBOR  
AERIAL VIEW - LOOKING N.E.  
JULY 17, 1960



at Beverly, Salem and Lynn, all within a radius of 6 miles of Marblehead. Each of these three cities has its own harbor facilities. The area is adequately served by land transportation including a branch line of the Boston and Maine Railroad, various bus lines and a network of improved highways.

#### PRIOR REPORTS

10. Marblehead Harbor has been the subject of investigation and reports dating back to 1852. Under authorization contained in the Act of 30 August 1852, the Federal Government expended \$500 on repairs to the sea wall on the south side of the causeway which connects Marblehead Neck with the mainland, at the southwesterly end of the harbor. A survey report, made in 1897 and published in House Document 289, 54th Congress, 2nd Session, found that there was no need for repairs to the sea wall at that time. An Act of 1899 provided for repairs to this sea wall, which were accomplished in 1903 at a cost of \$84. The most recent report was made in 1940 and published in House Document 85, 77th Congress, 1st Session, and was adopted in the 1945 River and Harbor Act. This report is the basis of review for the present study. A breakwater was studied in this 1940 report, but the one proposed by local interests, which would not narrow the entrance any, was found not feasible. Dredging in Little Harbor was also found not to warrant Federal participation. The two anchorage areas recommended in the 1940 study were authorized by Congress in 1945 but never dredged.

#### EXISTING CORPS OF ENGINEERS' PROJECT

11. The existing project was authorized by River and Harbor Acts of 3 March 1899, and 2 March 1945. It provides for repair to the sea wall, a 13-acre anchorage on the east side of the harbor 20 feet deep, and a 16-acre anchorage at the southwest end of the harbor, 9 feet deep. The total cost of the existing project through June 1958 has been \$84, which was maintenance money, spent on repair to the sea wall. No work has been done on dredging the anchorages. The estimated additional appropriation needed to complete the existing project is \$367,000 in addition to \$60,000 required local contribution, for a total estimated improvement cost (1958) of \$427,000. The latest (1945) approved estimate for annual maintenance is \$1,250. The 1945 project modification providing for dredging of the anchorages was classified as inactive in 1958 due to local unwillingness to meet the requirements of local cooperation, and local requests that breakwater construction be authorized and undertaken instead of dredging the anchorages.

## LOCAL COOPERATION ON EXISTING AND PRIOR PROJECTS

12. The River and Harbor Act of 2 March 1945 provided that local interests should contribute one-half the first cost, but not to exceed \$60,000, for the dredging of the two anchorage areas, and hold and save the United States free from all claims for damages that may result from the improvement. The State of Massachusetts, in 1946, offered to contribute one-half the required local contribution for the anchorages if the town was willing to contribute the remainder. A public meeting was held in the town to discuss this offer. At the meeting, considerable opposition was voiced to the dredging of anchorages, and it was their concluded opinion that any monies made available should be used for breakwater protection and not dredging.

## OTHER IMPROVEMENTS

13. In 1952, the causeway at the southwest end of the harbor, which connects Marblehead Neck with the mainland, was reconstructed by the Commonwealth of Massachusetts. The work consisted of a concrete revetment on the seaward side, granite stone revetment on the harbor side, raising of the road surface slightly, and the placement of a new bituminous concrete pavement. The accomplishment of this work overlays physically the portion of the existing project consisting of repairs to the sea wall. In view of this construction work by local interests, all future reference to repairs of sea wall under the existing project should be omitted.

## TERMINAL AND TRANSFER FACILITIES

14. There are three commercial landings which are located on the town side of the harbor and described as follows:

Marblehead Transportation Company: Marginal granite and concrete walls with extending gangways and wood floats 160 feet by 16 feet. Unloading facilities and service supplies are available. The wharf is open for business to fishermen and all boat owners, charter boat landing, mooring and fishing boat rentals.

Marblehead Yacht Yard: Marginal granite and concrete walls with extending gangways and wood floats 140 feet by 16 feet. Unloading facilities and supplies are available. It is open for business for all boat owners.

Marblehead Marine Center: Marginal granite and concrete walls with extending gangways and wood floats 60 feet by 16 feet. Unloading facilities and supplies are available. It is open for business for landing service and sales for recreational boats.

The depths of water alongside the above floats are about 16 feet.



15. There are two public landings located on the town side of the harbor at State Street and at Commercial Street, which are open to the public on equal terms. The State Street Wharf of granite and concrete walls is utilized by fishermen to unload their catch for truck delivery as well as by recreational and charter boats. Currently, design has been completed for the extension of the pier approximately 75 feet and planned for construction within the next two years. In addition, design has been completed for the construction and extension of the Commercial Street Wharf by the Commonwealth of Massachusetts. The new work is scheduled for completion in 1962.

16. There are seven yacht club floats and fourteen (14) private floats in the harbor for recreational landings. The yacht club floats, 3 of which are over 150 feet long, are well equipped for service and convenience of their members and guests. The depths at the yacht club landings range from 8 to 15 feet. The private landings have floats ranging from 20 to 60 feet in length.

17. There are 6 boat yards in Marblehead which can store about 550 boats and do an average gross business of over \$500,000 annually. The yards have a total of 7 railways and 4 cranes for handling boats.

#### IMPROVEMENT DESIRED

18. In order to afford local interests an opportunity to express their views with respect to the improvement to Marblehead Harbor, a public hearing was held at Marblehead on 27 January 1958. A complete record of the hearing is submitted with this report. The hearing was attended by about 280 people including two members of the House of Representatives of Massachusetts, a representative of the Public Works Department of Massachusetts, town selectmen, representative of the Chamber of Commerce, and Junior Chamber of Commerce, officers of numerous yacht clubs, members of a Special Committee to Study Harbor Improvements, local businessmen, and boat owners and private citizens from Marblehead and other nearby towns.

19. A special committee of 13 persons was appointed by the selectmen to collect data and present it at the hearing. The Committee secretary, Donald W. Gardner, was the spokesman for the group and presented the data marked as Exhibit 2, in the hearing transcript. The desired improvement this committee considered best for the protection of the harbor was a breakwater 1,500 feet long extending north magnetic from Lighthouse Point on Marblehead Neck.

20. This 1,500-foot breakwater suggested by the Harbor Improvement Committee was strongly supported by the majority of those who spoke. There were some in favor of building the breakwater more

northwesterly and restricting the entrance more while others advocated leaving the opening unobstructed for the convenience of sail boats. Opposition was expressed in a few letters which dwelt on the economic tax burden the improvement would put on the town and nation.

21. It was pointed out at the hearing that storms from the northeast quadrant result in rough seas which approach the harbor entrance, sweep around the end of Marblehead Neck, and continue into the harbor, creating conditions unfavorable to safe anchorage. During such storms, the outer position of the harbor is unfit for anchorage and the inner portion becomes so rough that anchored vessels are frequently torn from their moorings and are subject to severe damage by collision and grounding.

22. Local interests expressed the belief that the desired breakwater would break up the seas which now enter the harbor, thereby improving the safety of the anchorage area presently utilized and rendering the rough areas at the outer end of the harbor sufficiently quiet to serve as additional anchorage space. It was pointed out that the most severe northeast storms commonly occur in the spring and fall and that if the harbor was adequately sheltered by breakwater protection the yachting season could be appreciably lengthened.

23. Local interests expressed the opinion that the improved harbor condition which would result from breakwater protection would greatly stimulate yachting activity by attracting visiting craft in greater numbers and by encouraging more vessels to use Marblehead Harbor as a permanent base. It was also pointed out that the fishing fleet could have a longer season and the number of boats would increase. The resulting benefits which are claimed, include increased use of recreational and fishing boats as well as a decrease in storm damage, increased tax resources and increased income from the sale of supplies and expenditures for repair and storage of boats in local yards.

24. It was the general consensus of opinion of the local interests that the construction of a breakwater was more important than dredging the authorized anchorage areas for the improvement of the harbor. Also any local cash contributions should be used for the construction of a breakwater. It was also pointed out, in view of the boats of drafts up to 8 to 10 feet using the harbor that there was no need for dredging to the depth of 20 feet as part of the authorized project.

25. State officials were of the opinion that the State would be willing to cooperate with town officials in any improvement recommended by the Corps of Engineers. All town officials, committee members, business representatives, and most individuals that spoke were willing for the town to spend money for a fair share of the cost of a breakwater.

26. The Massachusetts Division of Fisheries and Game by letter dated 1 February 1961 requested consideration be given to modifying the proposed breakwater design to allow public fishing. The modification would consist of constructing the top of the breakwater to permit safe access by the public and construction of an access drive, walkways and a parking area. The recommendation of the State agency was coordinated with the local town officials.

#### EXISTING AND PROSPECTIVE COMMERCE

27. The only commerce reported in Marblehead Harbor in recent years is fish and fish products. There are 9 fishing companies presently deriving their support from the use of Marblehead Harbor. Published statistics for the calendar year 1959, show that 375 tons of fish and fish products and 300 tons of shellfish and products were landed at Marblehead. In the past 5 years, these companies have reportedly handled an average of 500 tons of fresh fish and lobsters annually. The approximate average annual gross sum paid to fishermen during the past five years was estimated at \$200,000 for lobsters and \$50,000 for ground fish for a total of \$250,000 annually. As noted in the U. S. Fish and Wildlife Service reported dated August 14, 1961 (see Appendix C), the lobster fleet based in the harbor catch about 250,000 pounds of lobster or 125 tons annually. The difference of about 175 tons to the published statistics is due to the import of lobster by dealers in Marblehead. Conversely, the difference in the published statistics of 375 tons of fish to the 1175 tons of fish reported by the Wildlife Service is due to fishermen landing their catch at other locations due to the storms, waves and swells that are predominant in Marblehead Harbor during the winter months. Marblehead is presently a home port for 90 fishing craft. With a protective breakwater local interests claim that this fleet would increase and a longer season would occur, thus resulting in a greater dollar return.

#### VESSEL TRAFFIC

28. Fifty-five of the 90 fishing craft that make Marblehead their homeport, are part time operators. This gives a total of 35 boats making the round trip about 200 days per year and the 55 part time boats making about 100 trips per year for a total of about 12,500 round trips annually. These fishing craft range from 18 to 50 feet in length.

29. Marblehead is widely famed as one of the greatest yachting centers of the Atlantic Coast. It advertises as the "Yachting Center of the World". The locally based fleet consists of 1000 boats ranging in length from 10 to 90 feet with an estimated value of about \$4,500,000. In addition, visiting yacht club fleets, start of ocean

ances, and transient cruisers each year amount to about 2,000 vessels with a market value of approximately \$10,000,000.

30. No record is kept of the vessel trips of pleasure craft but with the large number of locally based and transient craft, it is estimated there would be about 50,000 round trips made annually. Included in the above total of 1000 pleasure craft there is a charter boat fleet which consists of 50 day sailers, 18 to 30 feet long, and 39 cruisers, 21 to 100 feet long. Published statistics for the calendar year 1959, show the charter boat fleet made 18,932 vessel trips and carried 42,720 passengers.

#### DIFFICULTIES ATTENDING NAVIGATION

31. The principal difficulties said to attend navigation in Marblehead Harbor are concerned primarily with unsafe anchorage conditions. Storms from the northeast quadrant, it is claimed, result in heavy seas which approach from the east, sweep around the tip of Marblehead Neck, and proceed the full length of the harbor. Local interests claim this action renders areas near the entrance entirely unfit for anchorage and subjects vessels at anchor farther up the harbor to the danger of tearing loose from their moorings and suffering severe damage by collision or grounding. The Coast Pilot rates Marblehead Harbor as an excellent anchorage but further states that it is reported uncomfortable for small yachts when the wind is northeast. This roughness is said to discourage boats from using the harbor for temporary and permanent anchorage.

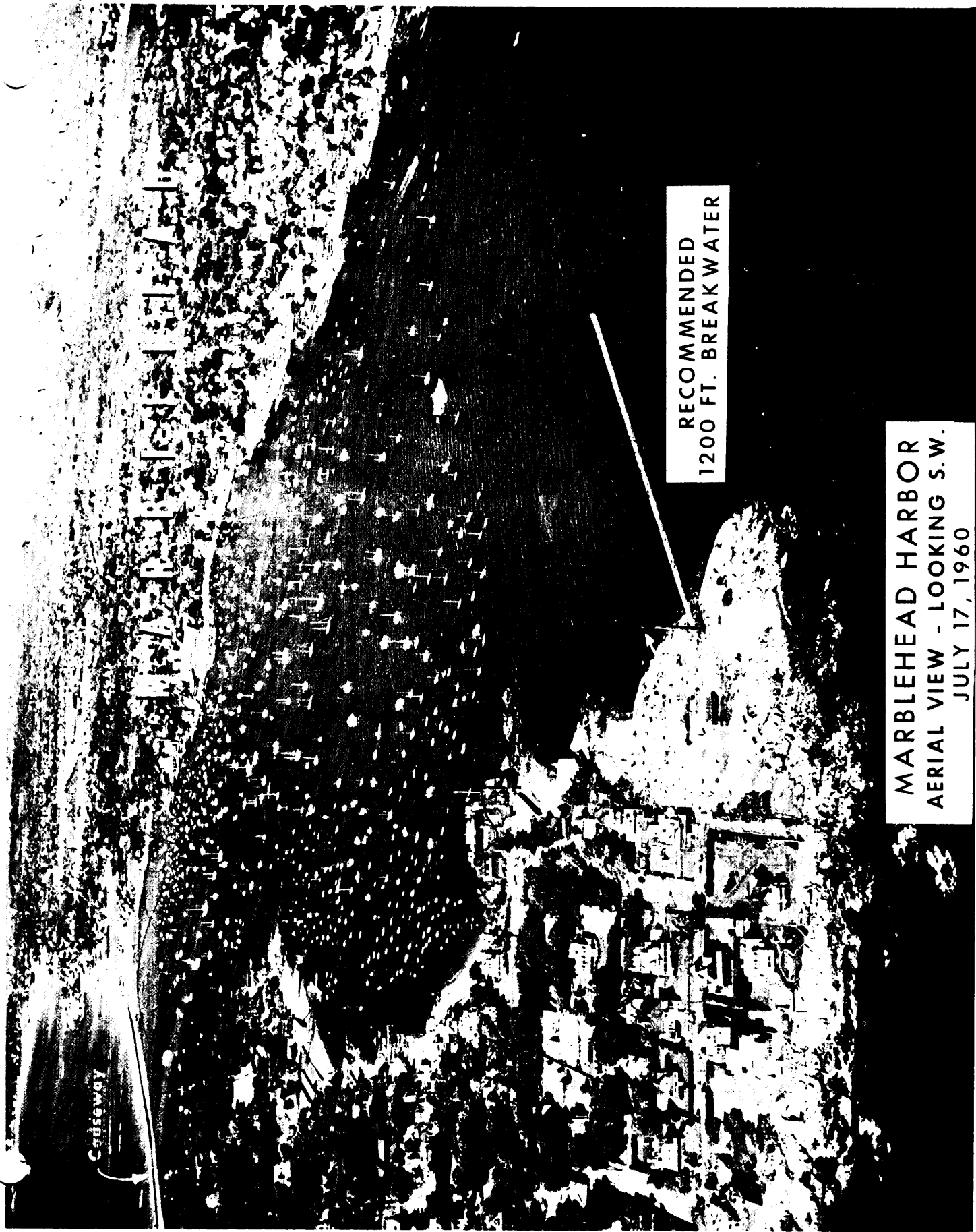
32. Wave studies indicate that under present conditions, the harbor area southwest of a line from Marblehead Neck light to Fort Sewall is subject to extreme storm wave action as follows: 4 to 5 foot waves, 115 acres; 5 to 10 foot waves, 45 acres; 10 to 15 foot waves, 25 acres; and 15 foot waves, 16 acres. The remaining approximately 60 acres of mooring area of the unprotected harbor would have waves less than 4 feet.

#### WATER POWER AND OTHER SPECIAL SUBJECTS

33. This investigation presents no problems pertaining to water power, flood control, pollution or related subjects. The desired improvement would have no adverse effect on wildlife or shellfish.

#### PLAN OF IMPROVEMENT

34. Two plans of improvement have been considered in this report. The first, advocated by the local interests, is a breakwater 1,500



Causeway

RECOMMENDED  
1200 FT. BREAKWATER

MARBLEHEAD HARBOR  
AERIAL VIEW - LOOKING S.W.  
JULY 17, 1960

feet long extending from Marblehead Neck on a line magnetic north. It was the opinion of local interests that a breakwater in this position would best serve the needs of the harbor. It was believed the breakwater would substantially reduce storm waves from the northeasterly quadrant, and would result in increased use of recreational craft, benefits to the fishing fleet and reductions in annual boat damages.

35. The second plan studied is a breakwater 1,200 feet long extending generally from the same point as the desired location, but in a northwesterly direction. This location takes advantage of a ridge resulting in a lesser amount of stone with a comparable savings in cost.

36. Wave studies (see Plate 3) made of wave heights and reductions of wave heights together with studies of wave diffraction and refraction showed the desired breakwater to be the most effective in overall protection of the harbor from storms from the northeast quadrant. However, the alternate location would be as effective for the harbor in general except its effectiveness in reducing storm waves at the mouth of the harbor at the end of the breakwater. The area not receiving an optimum degree of protection is outside of the concentration of waterfront structures and activities and is adjacent and off-shore of Fort Sewall.

37. The principal difference between the two improvements, other than construction costs, in realizing the potential of the harbor is the difference in the amount of additional anchorage area that would be added by the construction of the respective improvements. The desired breakwater would afford an additional area of about 19 acres more than the approximately 260 acres of mooring area provided by the alternate breakwater.

38. Wave studies pertinent to the effectiveness of the desired breakwater show that waves in excess of 4 feet will be eliminated, except for an area of about 9 acres which would be subjected to 4 to 6-foot waves. Wave studies pertinent to the effectiveness of the alternate breakwater show that waves in excess of 4 feet will be eliminated, except for an area of about 20 acres which would be subjected to 4 to 8-foot waves.

39. Design calculations and assumptions pertinent to the typical cross section for the breakwater are shown in Appendix B. Based on a significant wave height of 15 feet, the typical section of the breakwater should be as follows:

- a. Top elevation of 20 feet above mean low water.
- b. Side slopes of 1 on 2 from elevation of 20 feet above mean low water to 15 feet below mean low water, thence, 1 on 1.5 slope to the bottom.

c. Top width of 10 feet.

d. 10-ton armor stone, 2 layers thick.

40. The plan of improvement is based on the consideration that the present navigation needs of the harbor, and the proposed breakwater construction render unwarranted the dredging of the anchorages authorized in 1945, and that the existing project should be abandoned.

#### SHORELINE CHANGES

41. The desired improvement would have no effect on the adjacent shorelines.

#### REQUIRED AIDS TO NAVIGATION

42. The United States Coast Guard has been consulted in regard to establishing aids to navigation for the improvements under consideration. They have reported that the buoy identified as C "3" north of Gordon Rock would be discontinued, and if the 1,200-foot breakwater is constructed, the buoy east of C "3" would be moved north of its present location. A light will be required to suitably mark the breakwater. The estimated first cost of this work is \$2,000 with increased annual maintenance costs of \$130.

#### ESTIMATES OF FIRST COST

43. Estimates of first costs have been prepared for two plans of improvement: The desired improvement, a breakwater 1,500 feet long extending on a line magnetic north, and an alternate breakwater 1,200 feet long extending in a northwesterly direction. Aids to navigation will be provided by the U. S. Coast Guard.

44. The estimates of first cost for the two plans considered, based on price levels of July 1961 and including an allowance for contingencies, are detailed in Appendix A. A summary of the estimates of first cost for each item of the two improvements are as follows:

A. 1,500-FOOT DESIRED IMPROVEMENT

|                                |                |
|--------------------------------|----------------|
| Stone breakwater               | \$ 3,740,000   |
| Engineering and Design         | 28,000         |
| Supervision and Administration | <u>221,000</u> |

|  |              |
|--|--------------|
| Project Construction Costs (July 1961) | \$ 3,989,000 |
|--|--------------|

|                               |       |
|-------------------------------|-------|
| Pre-authorization Study Costs | 9,000 |
|-------------------------------|-------|

|                                  |              |
|----------------------------------|--------------|
| Aids to Navigation (Coast Guard) | <u>2,000</u> |
|----------------------------------|--------------|

|                                |              |
|--------------------------------|--------------|
| Total Project Cost (July 1961) | \$ 4,000,000 |
|--------------------------------|--------------|

B. 1,200-FOOT ALTERNATE IMPROVEMENT

|                                |                |
|--------------------------------|----------------|
| Stone Breakwater               | \$ 2,206,000   |
| Engineering and Design         | 28,000         |
| Supervision and Administration | <u>166,000</u> |

|  |              |
|--|--------------|
| Project Construction Costs (July 1961) | \$ 2,400,000 |
|--|--------------|

|                               |       |
|-------------------------------|-------|
| Pre-authorization Study Costs | 9,000 |
|-------------------------------|-------|

|                                  |              |
|----------------------------------|--------------|
| Aids to Navigation (Coast Guard) | <u>2,000</u> |
|----------------------------------|--------------|

|                                |              |
|--------------------------------|--------------|
| Total Project Cost (July 1961) | \$ 2,411,000 |
|--------------------------------|--------------|

ESTIMATES OF ANNUAL CHARGES

45. The estimated annual charges for the considered improvements are based on an anticipated project life of 100 years, at interest rates of 2.625 percent for the Federal investment and 3.5 percent for the Non-Federal public investment. Non-Federal investment costs are based on an apportionment of costs among interests in proportion to the benefits resulting from the improvement. Additional annual maintenance charge is based on replacing an average of approximately 1,000 tons of stone annually. The computations of annual charges are detailed below:



A. 1,500-FOOT DESIRED BREAKWATER

Federal Annual Charges

Corps of Engineers

|                                     |           |
|-------------------------------------|-----------|
| Interest (2,841,000 x .02625)       | \$ 74,600 |
| Amortization (\$2,841,000 x .00213) | 6,060     |
| Additional Annual Maintenance       | 7,500     |

United States Coast Guard

|  |            |
|--|------------|
| Interest and Amortization (2,000 x .02838) | 60         |
| Additional Annual Maintenance              | <u>130</u> |

|                       |           |
|-----------------------|-----------|
| Total Federal Charges | \$ 88,350 |
|-----------------------|-----------|

Non-Federal Charges

|                                   |              |
|-----------------------------------|--------------|
| Interest (1,157,000 x .035)       | \$ 40,500    |
| Amortization (1,157,000 x .00116) | <u>1,350</u> |

|                           |           |
|---------------------------|-----------|
| Total Non-Federal Charges | \$ 41,850 |
| Total Annual Charges      | \$130,200 |

B. 1,200-FOOT ALTERNATE BREAKWATER

Federal Annual Charges

Corps of Engineers

|                                   |           |
|-----------------------------------|-----------|
| Interest (1,761,000 x .02625)     | \$ 46,200 |
| Amortization (1,761,000 x .00213) | 3,750     |
| Additional Annual Maintenance     | 7,500     |

United States Coast Guard

|  |            |
|--|------------|
| Interest and Amortization (2,000 x .02838) | 60         |
| Additional Annual Maintenance              | <u>130</u> |

|                       |           |
|-----------------------|-----------|
| Total Federal Charges | \$ 57,640 |
|-----------------------|-----------|

Non-Federal Charges

|                                 |            |
|---------------------------------|------------|
| Interest (648,000 x .035)       | \$ 22,700  |
| Amortization (648,000 x .00116) | <u>760</u> |

|                           |           |
|---------------------------|-----------|
| Total Non-Federal Charges | \$ 23,460 |
| Total Annual Charges      | \$ 81,100 |

## ESTIMATES OF BENEFITS

46. Benefits to be derived from improvement of Marblehead Harbor by provision of a breakwater will be in part general and in part recreational. General benefits will accrue from reduction in storm damage to fishing vessels and increased use of the existing fishing fleet. Recreational benefits, which are considered to be equally general and local in nature, will result from elimination of storm damage to recreational craft, increased use of the harbor by the present local and transient fleets, and additions to the fleet as a result of the improvement.

47. Marblehead Harbor is exposed to the northeast. Wave studies of the harbor show that waves generated by winds from the northeast have a direct access to the harbor and deep water waves generated by winds from the east, bend around Marblehead Neck and enter the harbor. It is estimated 4 to 5-foot high waves are generated from the northeast and 15-foot ocean waves are generated from the east.

48. Wave studies indicate that without the improvement, the harbor area southwest of a line from Marblehead Neck light to Fort Sewall is subject to storm wave action ranging up to 15-foot waves, as described earlier under "DIFFICULTIES ATTENDING NAVIGATION."

49. Wave diffraction studies pertinent to the 1,500-foot desired breakwater show that waves in excess of 4 feet will be eliminated except for an area of 9 acres which will be subjected to 4 to 6-foot waves. Wave diffraction studies pertinent to the 1,200-foot alternate breakwater show that waves in excess of 4 feet will be eliminated except for an area of 20 acres which will be subject to 4 to 8-foot waves.

50. The general benefits to be derived from the improvement attendant to the fishing interests will consist of reduction in boat damages, extension of the lobstering season for the local lobster fleet, lobster boats will be able to fish for groundfish during the winter months, and an anticipated addition of one new boat to the groundfish fleet.

51. Information obtained from the local fishermen and boat yard operators indicates that the average annual damage sustained by fishing craft from storms is conservatively estimated to be about \$100 per boat. The fishing fleet based in the harbor is made up of 82 lobster boats and 8 trawlers and seiners. For the present fleet of 90 boats, the damage would amount to \$9,000 annually. It is estimated that of that total, 75 percent of the damages was sustained by storms from the northeasterly quadrant for which protection will be afforded by the breakwater. It is further estimated that the

breakwater will eliminate 75 percent of this damage or \$5,000. The savings in fishing boat damages of \$5,000 are applicable to the desired 1,500-foot breakwater and also to the 1,200-foot alternate breakwater.

52. The U. S. Fish and Wildlife Service by letter dated 14 August 1961 (see Appendix C) stated that as a result of the improvement, there would be an increased catch of lobster and groundfish by the home based fishing fleet. It is estimated the increased lobster catch would be about 12,500 pounds and an increased groundfish catch of 1,020,000 pounds annually. The increased fish catch is based on greater use of the home fleet. Inasmuch as the harbor is principally a recreational harbor, it is not expected that there will be an appreciable increase in the number of fishing craft. Therefore, benefits have been taken for the addition of only one boat to the groundfish fleet.

53. The lobster boats now operate between 15 April and 15 November for a total of about 200 days yearly. It is estimated the improvement will permit the lobstermen to operate 10 additional days per year. The average catch per day is 50 pounds or an estimated total catch for the 10 days of 500 pounds per boat. The increased catch by the 25 full time lobster boats would be 12,500 pounds. The average price of lobsters at Marblehead has been determined to be \$0.50 per pound. The gross value of the increased catch is  $\$0.50 \times 12,500$  or \$6,250. It is estimated the net value of the additional catch is 50 percent of the gross value. Thus the total net value becomes  $\$6,250 \times 0.50$  or \$3,125, say \$3,100. This benefit, general in nature, will accrue to either of the improvements.

54. Presently due to the rough seas predominant in the harbor during the winter months, the lobstermen converting to groundfishing have been unable to land their groundfish catch consistently at Marblehead. The lobstermen have stated if they have to land their catch at other nearby ports that considerable delays are encountered in unloading the catch and additional costs are incurred. Therefore, the lobstermen do not fish for groundfish during the winter months.

55. Based on a study made by the U. S. Fish and Wildlife Service, the improvement will permit the lobstermen to operate year round by converting their activities to groundfishing during the winter months. It is estimated that about 30 lobster boats will take advantage of the improvement and convert to groundfishing. It is estimated each boat will catch an average of 25,000 pounds. The average price of the fish landed at Marblehead has been determined at \$0.10 per pound. The gross value of groundfish per boat is  $\$0.10 \times 25,000$  or \$2,500. It is estimated that, similar to the additional lobster catch, the net value of the catch is 50 percent of the gross. Thus the net value per boat becomes  $\$2,500 \times 0.50$  or \$1,250. For the 30 boats, the general benefit to be derived would be  $30 \times \$1,250$  or \$37,500.

56. In addition, it is estimated that one gill net boat will be added to the base fleet as a result of the improvement. This boat would land an additional catch of 270,000 pounds per year. The gross value at \$0.10 per pound would be \$27,000. The net value of the catch at 40 percent of the gross value would be \$10,800. The total groundfish benefit to be derived from either improvement would be \$37,500 plus \$10,800 or \$48,300.

57. Benefits for the recreational fleet have also been estimated. The benefits have been evaluated as the gain in annual return which the owner of the craft would enjoy, if improvements were made. The annual net return to the owners of recreational boats has been taken as the net amount the owners would receive if they chartered to others. The value of this gain is expressed as a percentage of the current market value of the fleet. The gain represents the difference between present use of the harbor and the increased use that will be made possible as a result of improvement. Ideal return varies according to the size and type of boat. For this report, the ideal return would range from 12 percent for outboards to 8 percent for the larger boats, except 14 percent is used for full-time charter boats. In the determination of the value of the ideal return, consideration was given to the lack of protected anchorage which precludes the full use of the harbor for the boating season of May through September.

58. Increased use of the harbor would be a primary benefit accruing from the breakwater protection. The consensus of opinion of the proponents of the improvement is that the present boating season extends from the middle of May to the middle of September. This season is about 120 days long. This shortened season is due in part to a large number of absentee owners who do not like to leave their boats unattended during the early part of May and the latter part of September. The hazard of so doing is increased during this period of time because of occurrence of northeast storms with winds up to 50 to 60 miles per hour.

59. Another factor regarding increased use of the harbor occurs when northeast or easterly storm warnings are issued, causing a general exodus by the larger boats to more protected harbors such as Manchester, Beverly, the Danvers River and as far away as Boston. At times, these boats are away from Marblehead for a week's time thus losing full use of the harbor.

60. In addition, the harbor is subject to considerable ground swells from the east. It is estimated the local fleet will realize unrestricted use of the harbor immediately after improvement. This will also apply to the transient fleet that visit the harbor during the boating season.

61. The existing locally based recreational fleet consists of 1,000 boats. Of these, 90 are outboards, 121 inboards, 244 cruisers, 166 auxiliary sail, 290 sailboats and 89 charter boats. Benefits from increased use by the existing fleet have been computed. It is considered that either improvement will allow full unrestricted use of the harbor for this fleet, and annual benefits have been evaluated on this basis. The benefits will amount to \$17,800 annually, of which \$8,900 is considered general and \$8,900 local. A detailed evaluation of the benefits is shown in Table No. I.

62. It is reported by the local people there are about 2,000 recreational boats visiting the harbor annually with an average stay in the harbor of about 4 days per boat. For the 120-day transient boat season, this will amount to 8,000 boat days or the equivalent of 67 permanent boats. The benefits will amount to \$2,000 of which \$1,000 is considered general and \$1,000 local. Benefits for these boats are detailed in Table II.

63. Local interests predicted there would be an increase in number of 15 percent for new boats and 5 percent in transferred boats immediately after improvement. Additional anchorage area would be afforded by breakwater protection. At the present time, no moorings are placed seaward of a line drawn between Jack's Point and Fort Sewall as the area beyond that line is considered hazardous for mooring. The additional anchorage areas that would result from the breakwater has been measured to be 41 and 22 acres for the desired 1,500-foot breakwater and the alternate 1,200-foot breakwater respectively.

64. The local interests and the harbormaster have indicated the harbor at the present time is overcrowded. The situation is compounded due to the desire to moor in areas that are better protected due to the position of Marblehead Neck. It is estimated the breakwater will reduce the ground swell and storm waves in the area shoreward of the line between Jack's Point and Fort Sewall which will permit mooring over the existing area and to a point which will not result in an overcrowded condition.

65. It is believed the local interests are too optimistic in their estimate of an increase of 15 percent in new boats, and 5 percent for transferred boats. The harbormaster stated that he has refused about 50 requests each year for the last 3 years for additional moorings. Benefits have been computed on the basis of 101 boats transferring to the harbor and 33 new boats being added immediately upon completion of the 1,500-foot desired breakwater. The benefits would amount to \$1,700 for the transferred boats and \$10,100 for the new boats. Benefits for these boats are detailed in Tables III and IV.

TABLE I

## 1,500-FOOT BREAKWATER

BENEFITS TO PLEASURE BOATING  
(Existing Fleet)

| TYPE OF CRAFT   | LENGTH No. of (feet) Boats | DEPRECIATED VALUE |             | PERCENT RETURN |        | VALUE \$ | ON CRUISE      |           |          |         |    |
|---|----------------------------|-------------------|-------------|----------------|--------|----------|----------------|-----------|----------|---------|----|
|   |                            | AVERAGE \$        | TOTAL \$    | % OF IDEAL     | Future |          | Avg. % OF DAYS | SEASON \$ |          |         |    |
| RECREATIONAL FLEET  |                            |                   |             |                |        |          |                |           |          |         |    |
| Outboards   | 10-20                      | 90                | 1,000       | 90,000         | 12     | 90       | 100            | 1.2       | 1,080    | -       | 0  |
| Inboards  | 10-20                      | 121               | 1,800       | 218,000        | 10     | 95       | 100            | 0.5       | 1,090    | -       | 0  |
| Cruisers  | 15-30                      | 100               | 2,500       | 250,000        | 8      | 95       | 100            | 0.4       | 1,000    | 12      | 10 |
|   | 31-50                      | 102               | 7,500       | 765,000        | 8      | 95       | 100            | 0.4       | 3,060    | 18      | 15 |
|   | 51-60                      | 27                | 10,000      | 270,000        | 7      | 95       | 100            | 0.35      | 940      | 30      | 25 |
|   | 71-90                      | 15                | 25,000      | 375,000        | 7      | 95       | 100            | 0.35      | 1,300    | 42      | 35 |
| Aux. Sail   | 15-30                      | 90                | 2,000       | 180,000        | 8      | 95       | 100            | 0.4       | 720      | 6       | 5  |
|   | 31-40                      | 56                | 8,000       | 448,000        | 8      | 95       | 100            | 0.4       | 1,800    | 12      | 10 |
|   | 41-60                      | 20                | 15,000      | 300,000        | 7      | 95       | 100            | 0.35      | 1,050    | 24      | 20 |
| Sailboats   | 10-20                      | 100               | 800         | 80,000         | 11     | 95       | 100            | 0.55      | 440      | 0       | 0  |
|   | 21-30                      | 100               | 3,000       | 300,000        | 10     | 95       | 100            | 0.50      | 1,500    | 6       | 5  |
|   | 31-40                      | 60                | 7,000       | 420,000        | 9      | 95       | 100            | 0.45      | 1,890    | 12      | 10 |
|   | 41-60                      | 30                | 12,000      | 360,000        | 8      | 95       | 100            | 0.40      | 1,440    | 24      | 20 |
| CHARTER BOATS   |                            |                   |             |                |        |          |                |           |          |         |    |
| Cruisers  | 21-35                      | 20                | 5,000       | 100,000        | 14     | 95       | 100            | 0.7       | 700      | 12      | 10 |
|   | 36-50                      | 15                | 10,000      | 150,000        | 14     | 95       | 100            | 0.7       | 1,050    | 24      | 20 |
|   | 51-100                     | 4                 | 50,000      | 200,000        | 14     | 95       | 100            | 0.7       | 1,400    | 36      | 30 |
| Day Sailers   | 18-20                      | 50                | 1,000       | 50,000         | 14     | 95       | 100            | 0.7       | 350      | 0       | 0  |
| TOTALS  |                            | 1,000             | \$4,556,000 |                |        |          |                |           | \$20,810 | \$2,930 |    |
| Total Benefits \$20,810 - \$2,930 = \$17,880 Say \$17,800 |                            |                   |             |                |        |          |                |           |          |         |    |

TABLE II

## 1,500-FOOT BREAKWATER

BENEFITS TO PLEASURE BOATING  
(Transient Fleet)

| TYPE OF<br>CRAFT          | LENGTH No. of<br>(feet) Boats | DEPRECIATED VALUE |           | PERCENT RETURN          |          | ON CRUISE   |       |
|---------------------------|-------------------------------|-------------------|-----------|-------------------------|----------|-------------|-------|
|                           |                               | AVERAGE           | TOTAL     | % OF IDEAL              | VALUE    | AVG. % OF   | VALUE |
|                           |                               | \$                | \$        | IDEAL Pres. Future GAIN | \$       | DAYS SEASON | \$    |
| <u>RECREATIONAL FLEET</u> |                               |                   |           |                         |          |             |       |
| Outboards                 | -                             | -                 | -         | -                       | -        | -           | -     |
| Cruisers                  | 15-60 31                      | 8,000             | 248,000   | 7 95 100                | 0.35 870 | -           | -     |
| Aux. Sail                 | 15-90 16                      | 10,000            | 160,000   | 9 95 100                | 0.45 720 | -           | -     |
| Sailboats                 | 21-60 20                      | 5,000             | 100,000   | 9 95 100                | 0.45 450 | -           | -     |
| <u>CHARTER BOATS</u>      |                               |                   |           |                         |          |             |       |
|                           | -                             | -                 | -         | -                       | -        | -           | -     |
| TOTALS                    | 67                            |                   | \$508,000 |                         | \$2,040  |             |       |

Total Benefits: \$2,040, Say \$2,000 •

TABLE III

## 1,500-FOOT BREAKWATER

BENEFITS TO PLEASURE BOATING  
(Transferred Boats)

| TYPE OF CRAFT      | LENGTH No. of (feet) Boats | DEPRECIATED VALUE |          | PERCENT RETURN |             |                | VALUE \$ | ON CRUISE |             |             |     |
|--------------------|----------------------------|-------------------|----------|----------------|-------------|----------------|----------|-----------|-------------|-------------|-----|
|                    |                            | AVERAGE \$        | TOTAL \$ | % OF IDEAL     | Future GAIN | AVG. % OF DAYS |          | VALUE \$  |             |             |     |
|                    |                            |                   |          |                |             |                |          |           | IDEAL Pres. | Future GAIN |     |
| RECREATIONAL FLEET |                            |                   |          |                |             |                |          |           |             |             |     |
| Inboards           | 10-20                      | 20                | 1,800    | 36,000         | 10          | 95             | 100      | 0.5       | 180         | 0 0 0       |     |
| Cruisers           | 15-30                      | 15                | 2,500    | 37,500         | 8           | 95             | 100      | 0.4       | 150         | 12 10 15    |     |
|                    | 31-50                      | 5                 | 7,500    | 37,500         | 8           | 95             | 100      | 0.4       | 150         | 12 10 15    |     |
|                    | 51-60                      | 2                 | 10,000   | 20,000         | 7           | 95             | 100      | 0.35      | 70          | 30 25 20    |     |
| Aux. Sail          | 15-30                      | 20                | 2,000    | 40,000         | 8           | 95             | 100      | 0.4       | 160         | 6 5 10      |     |
|                    | 31-40                      | 5                 | 8,000    | 40,000         | 8           | 95             | 100      | 0.4       | 160         | 12 10 20    |     |
|                    | 41-60                      | 2                 | 15,000   | 30,000         | 7           | 95             | 100      | 0.35      | 100         | 24 20 20    |     |
| Sailboats          | 10-20                      | 10                | 800      | 8,000          | 11          | 95             | 100      | 0.55      | 40          | 0 0 0       |     |
|                    | 21-30                      | 10                | 3,000    | 30,000         | 10          | 95             | 100      | 0.5       | 150         | 6 5 10      |     |
|                    | 31-40                      | 2                 | 7,000    | 14,000         | 9           | 95             | 100      | 0.45      | 60          | 12 10 10    |     |
|                    | 41-60                      | 1                 | 12,000   | 12,000         | 8           | 95             | 100      | 0.4       | 50          | 24 20 10    |     |
| CHARTER BOATS      |                            |                   |          |                |             |                |          |           |             |             |     |
| Cruisers           | 21-35                      | 5                 | 5,000    | 25,000         | 14          | 95             | 100      | 0.7       | 170         | 12 10 20    |     |
|                    | 36-50                      | 3                 | 10,000   | 30,000         | 14          | 95             | 100      | 0.7       | 210         | 24 20 40    |     |
|                    | 51-100                     | 1                 | 50,000   | 50,000         | 14          | 95             | 100      | 0.7       | 350         | 36 30 100   |     |
| TOTALS             |                            | 101               |          | 410,000        |             |                |          |           | 2,000       |             | 290 |

Total Benefits \$2,000 - \$290 = \$1710, Say \$1,700



TABLE IV

1,500-FOOT BREAKWATERBENEFITS TO PLEASURE BOATING  
(New Boats)

| TYPE OF CRAFT      | LENGTH No. of (feet) Boats | DEPRECIATED VALUE |          | PERCENT RETURN |                         | ON CRUISE |                             |         |          |    |    |         |  |
|--------------------|----------------------------|-------------------|----------|----------------|-------------------------|-----------|-----------------------------|---------|----------|----|----|---------|--|
|                    |                            | AVERAGE \$        | TOTAL \$ | IDEAL          | % OF IDEAL Pres. Future | VALUE \$  | AVG. % OF VALUE DAYS SEASON |         |          |    |    |         |  |
|                    |                            |                   |          |                |                         |           |                             | GAIN \$ |          |    |    |         |  |
| RECREATIONAL FLEET |                            |                   |          |                |                         |           |                             |         |          |    |    |         |  |
| Cruisers           | 15-30                      | 8                 | 2,500    | 20,000         | 8                       | 0         | 100                         | 8       | 1,600    | 12 | 10 | 160     |  |
|                    | 31-50                      | 2                 | 7,500    | 15,000         | 8                       | 0         | 100                         | 8       | 1,200    | 18 | 15 | 180     |  |
|                    | 51-60                      | 1                 | 10,000   | 10,000         | 7                       | 0         | 100                         | 7       | 700      | 30 | 25 | 170     |  |
| Aux. Sail          | 15-30                      | 4                 | 2,000    | 8,000          | 8                       | 0         | 100                         | 8       | 640      | 6  | 5  | 30      |  |
|                    | 31-40                      | 1                 | 8,000    | 8,000          | 8                       | 0         | 100                         | 8       | 640      | 12 | 10 | 60      |  |
|                    | 41-60                      | 1                 | 15,000   | 15,000         | 7                       | 0         | 100                         | 7       | 1,050    | 24 | 20 | 210     |  |
| Sailboats          | 10-20                      | 9                 | 800      | 7,200          | 11                      | 0         | 100                         | 11      | 790      | 0  | 0  | 0       |  |
|                    | 21-30                      | 2                 | 3,000    | 6,000          | 10                      | 0         | 100                         | 10      | 600      | 6  | 5  | 30      |  |
|                    | 31-40                      | 1                 | 7,000    | 7,000          | 9                       | 0         | 100                         | 9       | 630      | 12 | 10 | 60      |  |
|                    | 41-60                      | 1                 | 12,000   | 12,000         | 8                       | 0         | 100                         | 8       | 960      | 24 | 20 | 190     |  |
| CHARTER BOATS      |                            |                   |          |                |                         |           |                             |         |          |    |    |         |  |
| Cruisers           | 21-35                      | 2                 | 5,000    | 10,000         | 14                      | 0         | 100                         | 14      | 1,400    | 12 | 10 | 140     |  |
|                    | 36-50                      | 1                 | 10,000   | 10,000         | 14                      | 0         | 100                         | 14      | 1,400    | 24 | 20 | 280     |  |
| TOTALS             |                            | 33                |          | \$128,200      |                         |           |                             |         | \$11,610 |    |    | \$1,510 |  |

Total Benefits: \$11,610 - \$1,510 = \$10,100

66. The benefits that would be derived by the transferred and new recreational boats from the construction of the 1,200-foot alternate breakwater is computed on the basis of the ratio of added anchorage areas. Therefore, the benefit would be  $22/41 \times \$1,700$  or \$900 for transferred boats and  $22/41 \times \$10,000$  or \$5,400 for new boats.

67. In view of exposure from northeast and easterly storms, the storm damage to recreational boats in the harbor is great. Local interests have estimated that over the most recent 10-year period, total storm damage would range from \$750,000 to \$1,250,000. As justification for this estimate, two bad storms were cited. It was estimated that damages in the amount of \$500,000 were experienced from the storms of hurricane proportions occurring in 1955. This figure was considered conservative as it only included damage which occurred to boats ordinarily hauled out at Marblehead. It did not include boats that are part of the existing fleet, which are ordinarily hauled out at other ports. Several boats were also damaged beyond repair during this storm. A strong northeast storm during 1958 was also cited. This storm caused the loss of a dozen small boats and two larger boats for a total of about \$70,000, excluding damage to other boats which have been repaired. It was estimated that this storm was responsible for \$100,000 worth of damage.

68. Due to the crowded conditions in the harbor, it has been necessary to shorten the scope of the anchor lines to the boats to allow for maximum mooring space. This is adequate under normal conditions. However, during storms originating from the northeast quadrant, high wave action is induced. This, in combination with a strong wind, tends to break boats away from the mooring thereby inflicting damage not only to the boats involved, but to others that may come in contact with them. By reducing the height of waves entering the harbor, this type of damage could be minimized.

69. It is estimated, based on figures reported by the local people, that the overall average annual damage sustained by recreational boats for all storms has been \$100,000 or about 2 percent of the valuation of the home based fleet.

70. In evaluating the benefits to be derived from the improvement relative to recreational boat damage, consideration has been given to the following: the frequency of major storms over the last 10 years; damage sustained due to dragging and/or separation from the moorings; the losses due to storms from directions other than the northeast quadrant, from which the breakwater will not afford protection; and the wave studies and reduction in storm waves if the breakwater is constructed.

71. In view of the above factors, it is estimated the 1,500-foot desired breakwater will eliminate 45 percent of the overall \$100,000 annual damage or \$45,000. Of this benefit, \$22,500 is considered general and \$22,500 local.

72. For the 1,200-foot alternate breakwater which is not quite as effective in reducing the storm waves for a small area contiguous to Fort Sewall, it is estimated that it will eliminate about 40 percent of the overall \$100,000 annual damage or \$40,000. Of this benefit, \$20,000 is considered general and \$20,000 local.

73. The annual benefits described above are summarized in the following tables:

TABLE V

1,500-FOOT DESIRED BREAKWATER

| <u>Source</u>              | <u>General</u> | <u>Local</u>  | <u>Total</u>  |
|----------------------------|----------------|---------------|---------------|
| <b>Fishing Boats:</b>      |                |               |               |
| Reduction in Storm Damage  | \$ 5,000       |               | \$ 5,000      |
| Increased Lobster Catch    | 3,100          |               | 3,100         |
| Increased Groundfish Catch | 48,300         |               | 48,300        |
| <b>Recreational Boats:</b> |                |               |               |
| Existing Fleet             | \$ 8,900       | \$ 8,900      | \$ 17,800     |
| Transient Fleet            | 1,000          | 1,000         | 2,000         |
| Transferred Boats          | 850            | 850           | 1,700         |
| New Boats                  | 5,050          | 5,050         | 10,100        |
| Reduction in Storm Damage  | <u>22,500</u>  | <u>22,500</u> | <u>45,000</u> |
| Total                      | \$94,700       | \$38,300      | \$133,000     |
|                            | 71%            | 29%           | 100%          |

TABLE VI

1,200-FOOT ALTERNATE BREAKWATER

| <u>Source</u>              | <u>General</u> | <u>Local</u>  | <u>Total</u>  |
|----------------------------|----------------|---------------|---------------|
| Fishing Boats:             |                |               |               |
| Reduction in Storm Damage  | \$ 5,000       |               | \$ 5,000      |
| Increased Lobster Catch    | 3,100          |               | 3,100         |
| Increased Groundfish Catch | 48,300         |               | 48,300        |
| Recreational Boats:        |                |               |               |
| Existing Fleet             | \$ 8,900       | \$ 8,900      | \$ 17,800     |
| Transient Fleet            | 1,000          | 1,000         | 2,000         |
| Transferred Boats          | 450            | 450           | 900           |
| New Boats                  | 2,700          | 2,700         | 5,400         |
| Reduction in Storm Damage  | <u>20,000</u>  | <u>20,000</u> | <u>40,000</u> |
| Total                      | \$89,450       | \$33,050      | \$122,500     |
|                            | 73%            | 27%           | 100%          |

COMPARISON OF BENEFITS AND COSTS

74. Comparison of the estimated annual benefits with the estimated annual carrying charges for the two considered improvements result in the following benefit cost ratios:

A. 1,500-FOOT DESIRED BREAKWATER

|                           |            |
|---------------------------|------------|
| Estimated Annual Benefits | \$ 133,000 |
| Estimated Annual Charges  | \$ 130,200 |
| Benefit Cost Ratio        | 1.0        |

B. 1,200-FOOT ALTERNATE BREAKWATER

|                           |            |
|---------------------------|------------|
| Estimated Annual Benefits | \$ 122,500 |
| Estimated Annual Charges  | \$ 81,100  |
| Benefit Cost Ratio        | 1.5        |

75. The above benefit cost ratios indicate that both locations can be justified if considered individually. However, the incremental benefits for the desired breakwater are \$10,500 which, when compared with the incremental annual charge of \$49,100, indicates an incremental benefit cost ratio of 0.2. It is, therefore, apparent that the extra cost of the desired breakwater is not economically justified.

## PROPOSED LOCAL COOPERATION

76. Local interests should provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction and maintenance of the project when and as required. Rights-of-way should include access to a contractor with his equipment to build the breakwater from land. Local interests should also hold and save the United States free from damages that may result from either the construction works or maintenance.

77. For projects of this type, it is usual to require that a public landing open to all on equal terms be provided. In the harbor there are two public landings available. In addition, there are other recreational landings that are open to business. However, local interests should provide assurances that the existing public landings or their equivalent will be adequately maintained during the life of the project and will be open to all on equal terms.

78. The benefits to be derived from improvement of Marblehead Harbor are partly local and partly general in nature. In the case of the 1,200-foot alternate breakwater, the local benefits are estimated as 27 percent of the total benefits. Since it is considered that local interests should share in the project costs commensurate with the local benefits to be derived, it is determined the local interests should make a cash contribution of 27 percent of the construction cost of the 1,200-foot alternate breakwater, exclusive of aids to navigation. The local cash contribution is estimated at \$648,000 (1961). Local interests have been consulted and have provided reasonable assurance that the above described requirements of local cooperation would be met.

## APPORTIONMENT OF COSTS AMONG INTERESTS

79. Construction costs for the 1,500-foot desired breakwater and the 1,200-foot alternate breakwater have been apportioned among interests in proportion to the benefits received. The ratios of evaluated general benefits to local benefits for the 1,500-foot breakwater and the 1,200-foot alternate breakwater are 71 percent to 29 percent and 73 percent to 27 percent respectively. The apportionments of costs are as follows:

A. 1,500-FOOT DESIRED BREAKWATER

Federal

|   |               |
|---|---------------|
| Corps of Engineers, General Navigation<br>facilities (0.71 x 3,989,000) | \$2,832,000 - |
| Preauthorization Study Costs  | <u>9,000</u>  |
| Sub-total   | \$2,841,000   |

out - ~~U. S. Coast Guard, Aids to Navigation~~ 2,000  
\$2,843,000

Non-Federal

|  |             |
|--|-------------|
| Local Cash Contribution (0.29 x 3,989,000) | \$1,157,000 |
| Total Project Cost                         | \$4,000,000 |

B. 1,200-FOOT ALTERNATE IMPROVEMENT

Federal

|   |              |
|---|--------------|
| Corps of Engineers, General Navigation<br>facilities (0.73 x 2,400,000) | \$1,752,000  |
| Preauthorization Study Costs  | <u>9,000</u> |
| Sub-total   | \$1,761,000  |

|                                       |              |
|---------------------------------------|--------------|
| U. S. Coast Guard, Aids to Navigation | <u>2,000</u> |
|                                       | \$1,763,000  |

Non-Federal

|  |             |
|--|-------------|
| Local Cash Contribution (0.27 x 2,400,000) | \$ 648,000  |
| Total Project Cost                         | \$2,411,000 |

The estimated additional annual maintenance costs for repairs to the breakwater ~~and for navigation aids~~ are considered to be Federal costs to be incurred by the Corps of Engineers, ~~and the U. S. Coast Guard~~.

COORDINATION WITH OTHER AGENCIES

80. All Federal, State, and local interests having an interest in the improvement of Marblehead Harbor were notified of the public

hearing held 27 January 1958. Officials of the Commonwealth of Massachusetts and the town of Marblehead and pleasure boat and fishing interests were consulted during the study concerning the effects of the proposed improvement on their activities. Officials of the Commonwealth and of the town of Marblehead have expressed approval of the proposed improvement and the willingness of local interests to cooperate in a Federal project.

81. The United States Coast Guard was advised of the improvements under consideration and was requested to comment on aspects pertaining to their interests. By letter of 4 May 1961, the Commander of the First Coast Guard District replied that a breakwater light would be required.

82. The Regional Office of the United States Fish and Wildlife Service was also requested to comment on the place of improvement. Their report (see Appendix C) indicated that the improvement would benefit the local fishing fleet. The report did not indicate that the proposed breakwater would have an adverse effect on fish and wildlife.

83. The Commonwealth of Massachusetts, Division of Marine Fisheries, and Fisheries and Game, have indicated (see Appendix C) their indorsement of the proposed breakwater relative to the additional protection afforded the fishing fleet. The Division of Fisheries and Game also requested the breakwater be modified to allow for fishing from the structure by the public. For comments by the state agencies and the town of Marblehead relative to public fishing from the structure see Appendix C.

#### DISCUSSION

84. Marblehead Harbor is recognized as one of the most important yachting centers in America. It also serves the needs of commercial fishing in the immediate area. It lies about 14 miles northeast of Boston Harbor and 11 miles southwest of Gloucester Harbor. With the excellent facilities for boat repairs and storage afforded by 6 local boat yards and the yacht club house facilities, the harbor attracts some 2,000 visiting recreational craft each year. Marblehead Harbor is one of the principal centers of yachting activities in the North Atlantic, with as many as 300 to 400 vessels racing in a single day.

85. In addition to the 1,000 recreational boats based in the harbor, there is a fishing fleet of 90 boats that is active in landings of lobsters and groundfish.

86. The existing Federal project, authorized by the River and Harbor Acts of March 3, 1899, and March 2, 1945, provides for repair to the seawall, dredging a 13-acre anchorage on the east side of the harbor to a depth of 20 feet, and dredging a 16-acre anchorage at the southwest end of the harbor to a depth of 9 feet. The total estimated improvement cost (1958) is \$427,000. The River and Harbor Act of March 2, 1945, provided that local interests should contribute one-half of the first cost, not to exceed \$60,000. The town of Marblehead held a public hearing on 23 January 1946 as a result of an inquiry by the Commonwealth of Massachusetts regarding the attitude of the town in contributing its share of the required cash contribution toward the construction of the anchorage project. There was no interest shown for the dredging of the anchorage areas and considerable opposition to the project was registered. There have been no further expressions of interest received regarding the authorized anchorage improvement. At the public hearing held on 27 January 1958, it was the consensus of opinion of the local interests that monies for local cooperation should be expended toward a breakwater and not for the dredging of the two authorized anchorage areas.

87. Marblehead Harbor is exposed to storm waves from the northeast quadrant which results in swells that make unsafe anchorage, considerable boat damage, curtails the recreational boating season and fishing operations. It is the opinion of the local interests that needs of the harbor could be best served by the construction of a breakwater extending from Marblehead Neck 1,500 feet on a line magnetic north. A minority opinion was expressed that the mouth of harbor should not be restricted so as to interfere with sailing boat races. Other locations were suggested such as an offshore breakwater in segments and spur breakwaters from the neck and the mainland. Preliminary investigations of the locations showed they would not be as effective in reducing storm waves and were not economically feasible.

88. Based on wave studies, the 1,500-foot breakwater proposed by the local interests would be unquestionably the most effective in reducing the storm waves and would result in the overall optimum use of the harbor.

89. The benefits to be derived from the improvement are general in nature for the reductions in storm damage to fishing boats and increased fish catches, and equally general and local in nature as to benefits from recreational boating, such as a result of increased use by the pleasure craft, additions to the fleet, and reduction in storm damage. In addition, there would be substantial benefits to the local economy which are considered to be secondary and are not evaluated in this report. The total benefits to accrue to the desired improvement (1,500-foot breakwater) would be \$133,000 of which 71 percent are general and 29 percent local.



90. The desired improvement would cost \$3,989,000 for construction which would, if justified, be shared 71 percent and 29 percent, Federal and non-Federal, respectively. In addition, there would be other Federal costs of \$9,000 for preauthorization studies and \$2,000 for additional navigation aids. The total Federal and non-Federal cost for the 1,500-foot breakwater project is estimated as (July 1961) \$4,000,000.

91. The evaluated annual benefits of \$133,000 when compared to the computed annual charges of \$130,200, indicates a benefit-cost ratio of 1.0 for the 1,500-foot desired breakwater.

92. Further studies were made to determine a location that would be more economically feasible and also to realize a reasonable beneficial use of the harbor. It was determined that an alternate location for a breakwater from about the same origin as the desired breakwater, extending 1,200 feet in a northwesterly direction merited consideration. This location is on a shallow ridge thereby reducing the cross section of the breakwater. The length was determined by extending the line to the same northeast and southwest axis of the harbor as set by the end of the desired breakwater.

93. The alternate breakwater considered in this report is not quite as effective in storm wave reduction and slightly reduces the additional anchorage area afforded by the improvement. However, it adequately meets the needs of the harbor.

94. The estimated cost of the alternate improvement is \$2,400,000 for construction which would be shared 73 percent (\$1,752,000) and 27 percent (\$648,000) Federal and non-Federal, respectively. In addition, there would be other Federal costs of \$9,000 for preauthorization studies, and \$2,000 for additional navigation aids. The total Federal and non-federal cost for this project is estimated as (July 1961) \$2,411,000.

95. The evaluated annual benefits of \$122,500 when compared to the computed annual charges of \$81,100 indicates a benefit-cost ratio of 1.5.

96. A comparison of the above benefits to the respective annual charges for the two breakwater plans considered results in a difference of \$10,550 in benefits versus a difference of \$49,100 in annual charges, indicating a benefit-cost ratio of 0.2 for the additional cost of the initially desired 1,500-foot breakwater. While the desired location has a benefit cost ratio of 1.0 considered by itself, the additional cost of construction over that of the alternate 1,200-foot breakwater is not economically warranted.

97. During the prosecution of the study, it was suggested by local interests, consideration be given to the feasibility of a pneumatic breakwater. Based on research of published bibliographies of works on this subject, including model studies, it is concluded that this method is not an economically effective method to provide protection to Marblehead Harbor. Therefore, no further consideration was given to the suggestion for a pneumatic breakwater.

98. At a meeting held in Marblehead, the question was raised as to the effect of the proposed breakwater would have on the sanitary pollution condition within the harbor. The same inquiry was also raised and discussed in the report contained in House Document No. 85 which is now under review. Since the public hearing held in 1938, the Board of Health has substantially eliminated the disposal of raw sanitary sewage into the harbor. Water samples taken in the harbor in 1959 showed a bacteria count range of a low of 280 to a high of 940, which is well below the standard of 2,400 required by the Massachusetts Department of Public Health for swimming activities.

99. It is the concensus of opinion of the town officials and the Massachusetts Department of Public Health that the construction of the proposed breakwater will have no appreciable effect on the sanitary condition of the harbor.

100. Consideration was given to a request of the Massachusetts Division of Fisheries and Game, by letter dated 1 February 1961 (see Appendix C), which was coordinated with the town officials of Marblehead, to modify the breakwater to permit public fishing from the structure. Compliance with the request would require that the top of the breakwater be constructed to permit safe access by the public, and the construction of onshore facilities consisting of access drive, walkways, sanitary facilities, and parking area. Preliminary studies and estimates of placing the top layer of stone for the top 10-foot width of the breakwater to a closer tolerance and chinking the voids, and for construction of the onshore facilities indicate that a benefit-cost ratio of about 1.8 would be obtained. Benefits were evaluated on the basis of an annual use by 20,000 persons at an estimated value of fifty cents per person.

101. In the analysis of the proposed modification to permit public fishing, consideration was given to the direct exposure to the ocean waves, tidal range, and wave run-up on the rough riprap slope which would occur in Marblehead Harbor. In view of the above conditions, and that the fishing would be from the slope at waters edge, there would be a continuous threat to the user and a serious safety hazard to the public. The provision of adequate non-integral structures to protect the public from such hazards would not be economically feasible.

102. A meeting was held in Marblehead on 19 May 1961 with local officials of the town of Marblehead and representatives of Commonwealth of Massachusetts agencies to determine their views on the plans of improvement. It was pointed out to the local interests that Federal participation in the modification of the project to permit access by the public for fishing from the structure did not appear to be practicable. It was noted that the exposure of the breakwater to wave action and the resultant safety hazards involved made such use unwise.

103. As a result of the meeting, the town of Marblehead, upon reconsideration of the proposed modification, to allow for public access to the proposed breakwater, requested, by letter dated 28 June 1961 (see Appendix C) that the public fishing concept be deleted from the plan of improvement. The Massachusetts Division of Fisheries and Game maintained their position that the modification should be considered for the benefit of the public, however, no commitments were forthcoming as to assuming any financial responsibilities for the cost of such a modification. In view of the serious hazard involved, and local opposition to such use, no further consideration was given to this item of improvement.

104. Additional information on recommended and alternate projects called for by Senate Resolution 148, 85th Congress, 1st Session adopted 28 January 1958 is contained in attachment to this report.

#### CONCLUSIONS

105. The desires of local interests and the present and prospective needs of navigation at Marblehead Harbor would be met by a Federal navigation project to provide a breakwater 1,200 feet in length extending in a northwesterly direction from Marblehead Neck in lieu of dredging the 9-foot and 20-foot anchorage areas which are a part of the existing project. This improvement would result in benefits to recreational boating and fishing vessels that would yield a ratio of annual benefits to annual costs of 1.5. Local interests are willing and able to meet the indicated requirements of local cooperation, including a cash contribution of 27 percent of the cost of the project.

#### RECOMMENDATIONS

106. In view of the foregoing, the Division Engineer recommends that the existing project for Marblehead Harbor be abandoned, and in lieu thereof, a project be adopted to provide for a stone breakwater 1,200 feet long, top width of 10 feet, top elevation of +20.0, extending in a northwesterly direction from Marblehead Neck.

107. The total estimated construction cost of the recommended breakwater is \$2,400,000, with \$7,500 additional annual maintenance.

108. This modification is recommended subject to the condition that local interests:

a. Make a cash contribution of 27 percent of the construction cost, said contribution currently estimated at \$648,000 (1961).

b. Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction and maintenance of the project when and as required. Rights-of-way should include access to a contractor with his equipment to construct the breakwater from land.

c. Hold and save the United States free from damages that may result from construction and subsequent maintenance of the project.

d. Provide assurances that the existing public landings or their equivalent will be adequately maintained during the life of the project and will be open to all on equal terms.

OTTO J. ROHDE  
Colonel, Corps of Engineers  
Acting Division Engineer



# MARBLEHEAD HARBOR

## APPENDIX A

### ESTIMATES OF FIRST COST

1. The first costs are given below for the two plans of improvement. Federal construction consists of the placement of a stone breakwater. The U. S. Coast Guard will provide the necessary additional navigation aids.

2. The quantities of stone include allowances for settlement, based on probings taken at time of the field survey. Cost estimates are based on prices prevailing in July 1961.

3. The detailed estimates of cost are as follows:

#### PROJECT COST ESTIMATES

##### DESIRED IMPROVEMENT

##### 1500-FOOT BREAKWATER

| <u>Cost Account<br/>Number</u> | <u>Item</u>                      | <u>Cost Estimate<br/>(x \$1,000)</u> |
|--------------------------------|----------------------------------|--------------------------------------|
| 09                             | Stone, 500,000 tons              |                                      |
|                                | @ \$6.50 . . . . .               | \$3,250.0                            |
|                                | Contingencies 15% <u>490.0</u>   |                                      |
|                                |                                  | \$ 3,740.0                           |
| 29                             | Preauthorization Studies         | 9.0                                  |
| 30                             | Engineering and Design           | 28.0                                 |
| 31                             | Supervision and Administration   | <u>221.0</u>                         |
|                                | Corps of Engineers Total         |                                      |
|                                | (July 1961)                      | \$ 3,998.0                           |
|                                | Aids to Navigation (Coast Guard) | <u>2.0</u>                           |
|                                | Total Project Cost (July 1961)   | \$ 4,000.0                           |

ALTERNATE IMPROVEMENT

1200-Foot Breakwater

| <u>Cost Account<br/>Number</u> | <u>Item</u>                      | <u>Cost Estimate<br/>(x \$1,000)</u> |
|--------------------------------|----------------------------------|--------------------------------------|
| 09                             | Stone, 295,000 tons              |                                      |
|                                | @ \$6.50 . . . . . \$1,918.0     |                                      |
|                                | Contingencies @ 15% <u>288.0</u> | \$ 2,206.0                           |
| 29                             | Preauthorization Studies         | 9.0                                  |
| 30                             | Engineering and Design           | 28.0                                 |
| 31                             | Supervision and Administration   | <u>166.0</u>                         |
|                                | Corps of Engineers Total         |                                      |
|                                | (July 1961)                      | \$ 2,409.0                           |
|                                | Aids to Navigation (Coast Guard) | <u>2.0</u>                           |
|                                | Total Project Cost (July 1961)   | \$ 2,411.0                           |

# SURVEY OF MARBLEHEAD HARBOR, MASSACHUSETTS

## APPENDIX B ✓

### DESIGN OF IMPROVEMENT

1. Marblehead Harbor is exposed to storm waves generated from the northeast quadrant. The axis of the harbor is approximately NE-SW. It is claimed that storms approaching from the east result in heavy seas which sweep around the tip of Marblehead Neck and proceed the length of the harbor. This action renders areas near the entrance to the harbor unfit for anchorage and subjects vessels to storm damage further down the harbor.

2. A breakwater at the harbor mouth, generally, as desired by the local interests to reduce storm waves would best serve the navigation needs of the harbor.

3. Refraction studies relative to determining design wave heights at the mouth of the harbor were made for wind generated waves approaching from the east with an unlimited fetch, from the northeast with a fetch of 6 miles, and from the north-northeast with a fetch of 4 miles. The refraction diagrams are shown on Plate 3 attached to this report. "It is to be noted that local wind waves from the northeast in combination with long period waves from the east result in a chop in a large part of the harbor."

4. A design wave of 15 feet was determined for storms originating from the east. Due to the irregularity of the bottom contours, it was found that the orthogonals diverged to such an extent upon approaching the entrance to the harbor, that refraction coefficients of 0.3 or less were obtained for wave periods of 10 seconds or greater. As refraction coefficients of less than 0.5 are considered to be unreliable, a coefficient of 0.5 has been used to obtain the design wave height. Significant wave heights of between 25 and 30 feet were obtained at the deep water station of Nauset Beach, Cape Cod, Massachusetts for a total of 12 hours between the years of 1948 and 1950 (T.M. No. 55). Thirty-foot waves reduced by a refraction coefficient of 0.5 results in a design wave of 15 feet in height.

5. Computations for the design wave approaching the harbor, based on a 45-mile per hour wind, for a 6-mile fetch from the northeast and a 4-mile fetch from the north-northeast result in design waves of 5 feet and 4 feet respectively.

6. Based on wind observations recorded at Logan Airport, Boston, Massachusetts over the period of 1954 to 1960 inclusive, sustained wind velocities from the northeast quadrant are tabulated as follows:



| Period -                                      | Total Hours of Wind from Northeast |               |               |
|---|------------------------------------|---------------|---------------|
|   | Over                               | Over          | Over          |
|   | <u>25 MPH</u>                      | <u>39 MPH</u> | <u>47 MPH</u> |
| Period 1954-1960 inclusive                    | 902                                | 62            | 7             |
| Months of June, July, August<br>and September | 31                                 | 5             | 2             |
| Months of May and October                     | 151                                | 0             | 0             |

7. Based on the above design waves and approaching directions, preliminary studies were made of the following locations for a breakwater to shelter the harbor.

a. The desired improvement proposed by local interests, a breakwater extending 1500 feet in a magnetic north direction from Marblehead Neck.

b. An alternate improvement, a breakwater extending 1100 feet in a magnetic north direction with the same point of origin as a. above.

c. An alternate improvement, a breakwater extending 1200 feet in a northwesterly direction from the same point of land as a. above.

d. An alternate improvement proposed by one of the local people at the public hearing, two 700-foot spur breakwaters originating from opposite shores from Marblehead Neck and from Fort Sewall.

8. Preliminary diffraction wave studies were made for the four proposed breakwater layouts to determine the effectiveness of the individual sites in reducing the storm waves entering the harbor. It was considered that if the 15-foot storm waves approaching from the east could be reduced to less than 4 feet any reduction to the storm waves from the northeasterly would provide a safe anchorage for recreational and fishing craft in the harbor during periods of storm conditions. The preliminary studies indicated that the 1500-foot breakwater was the most effective in reducing the storm waves in attaining a greater area of protected anchorage within the harbor of waves less than 4 feet. Based on comparative areas susceptible to storm waves over 14 feet it was found that the 1100-foot breakwater and the two 700-foot spur breakwaters would be approximately 80 percent as effective as the 1500-foot and 1200-foot breakwaters in reducing storm waves in the harbor.

9. Inasmuch as the estimated cost of construction of the two 700-foot spur breakwaters would be equal to that of the 1500-foot breakwater and with less benefits accruing thereto, no further

consideration was given to this scheme. While the 1100-foot breakwater would provide some protected anchorage it would be insufficient to provide for the prospective needs of the harbor. Therefore, no further consideration was given to the 1100-foot structure.

10. The 1200-foot breakwater extending northwesterly was considered, to take advantage of lesser water depth than at the location of the 1500-foot breakwater which would result in a comparable decrease in construction costs. The length of the alternate breakwater was chosen so that the seaward end would be on the line from the seaward end of the 1500-foot breakwater that would be approximately parallel to the NE-SW axis of the harbor. Thus the degree of reduction of storm waves that would be effected by the two breakwaters would be comparable except for a small area at the mouth of the harbor. The 1500-foot breakwater would afford a slightly larger protected anchorage area within the harbor than the 1200-foot breakwater.

11. For the design of the typical section of the breakwater, Hudson's Formula was used. Based on a 15-foot design wave, 165 pounds per cubic foot stone, and a K sub delta of 3.5, a slope of 1 on 2 and a size of armor stone of 10-ton was obtained. The use of 10-ton armor stone which is available in this area, is considered to be more economical than to flatten the slope of the face of the breakwater in view of the depths of water involved. Flattening the slope would result in a considerable increase in volume of the stone to be placed. The 1 on 2 slopes should extend down to one design wave height, or 15 feet, below mean low water. Thence the slope should be steepened to 1 on 1.5. The width of the crest should be at least 2 stones wide. Based on 10-ton stone of a width of 4.5 to 5 feet the crest width would be 10 feet.

12. The ~~length~~<sup>HEIGHT</sup> of the breakwater was predicated on the run-up of the long period deep water wave generated from the east of an unlimited fetch. It was determined that the 15-foot wave at the breakwater in the 30-foot depth of water had a wave steepness factor of 0.05. Based on a steepness factor of 0.05, a run-up factor of 0.95 was applied to the 15-foot wave. Therefore, the wave run-up would be in the order of 14 feet and when added to a still water level of 13 feet above mean low water (based on an extreme range of tide of 12.7 feet at Salem Harbor) results in a storm wave run-up to an elevation of 27 feet at the proposed breakwater location. 14 feet

13. It is concluded the top of the breakwater should be set at 20-feet above mean low water for the following reasons:

a. The overtopping of the breakwater by the wave run-up of 6 to 7 feet would not have a significant effect on the wave action within the harbor as a whole.

b. The occurrence of the 15-foot deep ocean wave at the breakwater at the time of extreme range of tide would be infrequent.

c. As seen from Plates 1 and 3, due to the location of the 1200-foot breakwater at Marblehead Neck and the oblique angle of approach of the reported 15-foot deep ocean wave the maximum overtopping would only occur over the outer portion of the breakwater.

14. Therefore, it is concluded that consideration should be given to the 1500-foot desired breakwater and 1200-foot alternate breakwater of a typical section as follows:

a. Top elevation of 20 feet above mean low water.

b. Surface side slopes of 1 on 2 from elevation of 20 feet above mean low water to 15 feet below mean low water, thence, 1 on 1.5 slope to the bottom.

c. Top width of 10 feet.

d. 10-12 ton armor stone, 2 layers thick.

# MARBLEHEAD HARBOR, MASSACHUSETTS

## APPENDIX C

### FISH AND WILDLIFE

The U. S. Fish and Wildlife Service and the Commonwealth of Massachusetts Division of Fisheries and Game were requested to comment on the proposed improvement. Their comments and comments by the Town of Marblehead relative to the aspect of allowing public fishing from the proposed breakwater are contained in the following pages:

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
Fish and Wildlife Service

August 14, 1961

Division Engineer  
New England Division  
U.S. Corps of Engineers  
424 Trapelo Road  
Waltham 54, Massachusetts

Dear Sir:

This letter constitutes our conservation and development report on the proposed navigation improvements for Marblehead Harbor, Massachusetts. The Massachusetts Division of Marine Fisheries and Division of Fisheries and Game have cooperated with us in these studies and concur in this report. This report gives an evaluation of the commercial and principal sport fishery resources associated with the project.

The plan of improvement consists of construction of a 1500 foot breakwater extending north from Lighthouse Point on Marblehead Neck at the entrance to the harbor.

The harbor supports two commercial fisheries and a sport fishery. The commercial fisheries consist of a lobster fishery and a groundfish fishery.

Lobster fishery

There are 80 boats in the harbor that are used for catching lobsters. Only 25 of these boats fish on a full-time commercial basis. The lobster landings at Marblehead total approximately 250,000 pounds annually.

Groundfish fishery

There has been increased activity in groundfishing for the past 4-5 years. This has been due mainly to an increase in numbers of larger boats that specialize in this fishery. Nine boats of various tonnage fishing several methods land approximately 2,350,000 pounds of groundfish annually. The season for this fishery is generally from November to May.

Rough weather conditions, which reduce fishing activity, often prevail within the harbor during the winter months. Many times the commercial fishermen cannot unload their catch at Marblehead and must travel to more protected harbors along the coast. When the fishermen travel to more protected areas to land their catch there is little guarantee of an immediate buyer for the catch; this results in considerable delays before unloading.

Sometimes the fishermen "ice-up" their catch at Marblehead to wait until the next morning in order to receive better prices at landing. Frequently, they cannot reach their boats the next day to unload because of adverse harbor conditions. These circumstances lead to depressed fishing activities during the winter months, and discourage many fishermen from participating in groundfishing during the winter.

#### Sport Fishing by party boats

There are 2 boats which presently can be chartered by sportfishing parties. One boat can accommodate up to 34 persons who bottom-fish for sport. The rate charged is a minimum of \$100 for 20 persons and \$5 per individual for each person over 20 in number. The average party usually consists of 25 persons; therefore, the average cost per trip is \$125 to the fishermen. The other boat will carry up to 6 fishermen per trip to sport fish by trolling at a cost of \$80 per trip to the fishermen. Both boats operate from about May 15 to October 1, but requests for reservations before and after these dates are an annual occurrence.

The harbor improvements will benefit the commercial fishing fleet by facilitating its operation, particularly during the winter months. We anticipate that existing landings of lobsters would be increased by 5 percent, or 12,500 pounds annually. With a projected average price of \$.50 per pound, this increase in lobster landings will add \$6,250 annually to the gross income of the lobster fishermen as a result of the project.

Additional anchorage facilities and more favorable harbor conditions as a result of the breakwater are expected to attract some fishermen to an expanded groundfish fishery. It is anticipated that 30 lobster boats would line trawl for groundfish and average 25,000 pounds of fish per boat per year for a total increase of 750,000 pounds of fish. At an average of \$.10 per pound, this fishery would have a gross benefit of \$75,000. It is anticipated that gill net operations would increase by 1/3 with one additional boat added to the existing fleet for an increased landing of 270,000 pounds of groundfish per year. At an average of \$.10 per pound, this fishery would attain a gross benefit of \$27,000. Thus, the proposed breakwater would add \$102,000 annually to the gross income of fishermen catching groundfish.

The proposed breakwater would enable the party boat operators to extend their operations from about May 1 to October 15. It is estimated that each boat would thereby average 12 more parties per year. Twelve additional parties fishing for bottomfish at \$125 per party would add \$1,500 to the annual gross income of the first boat. Twelve additional parties trolling for sportfish at \$80 per party would add \$960 to the annual gross income of the second boat. Thus, the additional parties for both boats would add \$2,460 annually to the gross income of the owners of these sportfishing boats.

It is expected that the breakwater will attract sport fishermen who will fish from that structure. Maximum fishermen use of the breakwater can be obtained only if the structure is capped with a smooth surface and open to public access. If constructed with a suitable surface and convenient access, the breakwater will provide an estimated 20,000 man days of fisherman use annually, having a net value for the recreational aspects of approximately \$30,000.

In summary, the annual increase in commercial fishery benefits at dockside as a result of the breakwater would be (1) lobster fishery -- \$6,250, and (2) groundfish fishery--\$102,000. The annual increase in party boat rentals for sport fishing would be \$2,460 making a grand total of \$110,710. A capped breakwater having public access will produce an additional sport fishery having a net value of \$30,000 annually.

It is recommended that the breakwater be provided with a safe and easy access for land-based fishermen.

The opportunity to report on this project is appreciated.

Sincerely yours,



John S. Gottschalk  
Regional Director  
Bureau of Sport Fisheries & Wildlife



Russell T. Norris  
Acting Regional Director  
Bureau of Commercial Fisheries



# *The Commonwealth of Massachusetts*

*Department of Natural Resources*

*Division of Marine Fisheries*

*15 Ashburton Place, Boston 8*

February 1, 1961

Lt. Colonel Richard Erlenkotter  
Corps of Engineers  
424 Trapelo Road  
Waltham 54, Massachusetts

Dear Sir:

Referring to your communication of January 27 concerning a proposed breakwater at the entrance to Marblehead Harbor, this breakwater would increase the protected anchorage area tremendously. Not only would the fish fleet secure additional protection, but during the boating season, this harbor is filled with yachts.

Any protection of this type would reduce sea action thereby reducing the tendency for vessels to drag their moorings which in turn would save thousands of dollars damage to the vessels moored here. Any breakwater improves the habitat for certain species of fish frequenting the immediate vicinity.

A breakwater such as the one proposed has long been needed at Marblehead.

Very truly yours,

*Frederick C. Wilbour, Jr.*

Frederick C. Wilbour, Jr.  
Director

FCW/eg





# *The Commonwealth of Massachusetts*

## *Division of Fisheries and Game*

*73 Tremont Street, Boston 8*

February 1, 1961

Lt. Colonel Richard Erlenkotter  
Corps of Engineers  
Executive Office  
424 Trapelo Road  
Waltham 54, Mass.

Dear Colonel Erlenkotter:

I have your letter of January 27, 1961 requesting this Division's comments on the benefits to fish and wildlife of proposed improvements to Marblehead Harbor consisting of the construction of a breakwater.

Please be advised that we would not anticipate that the proposed breakwater would have any adverse effect on the fish and wildlife resources of the area.

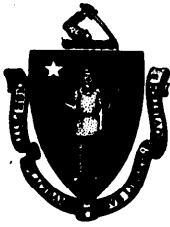
We believe, however, that the breakwater could be of value to the fishermen of the commonwealth if it could be constructed so as to allow fishing from it. We therefore recommend that the breakwater be so constructed as to allow persons to walk along the top and that access to the breakwater be provided along with provision for parking of cars for those persons desiring to use it.

I want to thank you for the chance to comment on this proposed project and hope that my recommendations can be incorporated in the project plans.

Sincerely yours,

  
CHARLES L. McLAUGHLIN  
DIRECTOR

CLM:pg  
c.c. J. Gottschalk, F. & W. Serv.  
J. Shepard  
G. Pushee



# *The Commonwealth of Massachusetts*

## *Division of Fisheries and Game*

*73 Tremont Street, Boston 8*

18 April 1961

Karl F. Eklund  
Colonel, Corps of Engineers  
Deputy Division Engineer  
424 Trapelo Road  
Waltham 54, Massachusetts

Dear Colonel Eklund:

I shall attempt to answer your queries relative to the proposed breakwater at Marblehead Harbor in the order in which they were posed:

It is suggested that the top of the breakwater be surfaced in order to allow for maximum recreational usage. If such a plan would be without the financial resources available, it might be possible to construct a ramp at each side of the slopes. We do not believe that any elaborate safety precautions are required with the exception of permanent installations for the storage of approved lifebuoys.

At a recent meeting with the town selectmen, it was pointed out that such a structure would be of benefit not only in regard to fishing, but also for use as an observation point in the yachting activities which abound in the harbor in question. Your third question relative to the number of fishing docks for use by the public I presume to mean now in existence in the area. The entire coastline of Massachusetts contains only 22 piers now open to the public. These piers help support over 230,000 shore fishing trips during the 200 plus-or-minus days that the salt water fishing season runs. None of these are located in Marblehead, Swampscott, or in Beverley. There is a small one in Salem but none in Manchester or Gloucester.

An examination of the area by personnel from this Division and the Marblehead Town Conservation Commission suggested that the present park now owned by the town could be utilized for parking areas. This would entail a moderate amount of grading and filling. It was felt that the town, through the park commission, could make this area available for this purpose. All town officials interviewed seemed amenable toward such an improvement.

It would be unrealistic to even infer that there will not be complainants among contiguous property owners relative to the proposal. It is not felt that such opposition would be of such magnitude as to constitute an harassment or give embarrassment to the agencies involved.

Maximum usage of such an improved structure is placed at 1,000 persons in one day. Rest-rooms are already in place as a portion of the park facilities. It is felt, based on an extensive survey of the marine sports fisheries of Massachusetts made during the past year, that this structure may well be in use for as long as 250 days during any year in which weather would permit and would supply approximately 20,000 fishing trips.

The monetary value to each person per day for the use of the facility can probably best be compared to that fee that they are willing to part with for the use of state parks. This office feels that a fifty-cent fee for adults could easily be postulated. The value of such an installment would have to be enlarged to cover the economics as it would apply to Marblehead and surrounding areas and expressed in terms of increased commercial sales of bait, gear, and condiments that are so necessary a part of the fisherman's expenses.

This Division has been assured by the Chairman of the Board of Selectmen that local interests are capable of policing and maintaining such an area.

In view of the above, the Division of Fisheries and Game most emphatically reiterates its recommendation that the proposed break-water in Marblehead Harbor be so modified as to allow public fishing.

Very truly yours,

  
Charles L. McLaughlin,  
DIRECTOR

CLMcL/dd



# *The Commonwealth of Massachusetts*

## *Division of Fisheries and Game*

*73 Tremont Street, Boston 8*

July 19, 1961

Karl F. Eklund  
Colonel, Corps of Engineers  
Deputy Division Engineer  
424 Trapelo Rd.  
Waltham 54, Mass.

Dear Colonel Eklund:

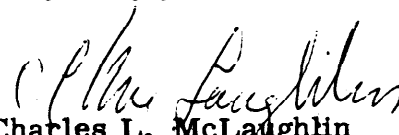
In reply to your letter dated 12 June 1961 relative to modifications of the proposed breakwater at Marblehead Harbor to accommodate recreation in the form of public fishing and observation of harbor activities, the Division of Fisheries and Game emphatically reiterates the position advanced in correspondence dated 18 April 1961.

The projected public use benefits derived from the incorporation of a multiple-use objective in the project plan for the proposed Marblehead breakwater warrant serious consideration.

Multiple-use objectives have been concomitant with various Corps' of Engineers projects to facilitate public use benefits. Numerous dams, piers, and access sites have been treated accordingly.

Consequently, the Division of Fisheries and Game would like to go on record as deeming a multiple purpose breakwater in Marblehead Harbor as feasible and beneficial not only to the Town of Marblehead and the Commonwealth of Massachusetts, but to the populace from more distant areas as well.

Very truly yours,

  
Charles L. McLaughlin  
Director

CHB:ak



JAMES N. SKINNER, CHAIRMAN  
J. ARCHER DIXEY  
NORRIS W. HARRIS  
J. HILARY ROCKETT  
CHESTER M. SAWTELLE  
CLARENCE E. CHAPMAN, CLERK

OFFICE OF  
**Board of Selectmen**  
ABBOT HALL

MARBLEHEAD, MASS.

June 28, 1961

Karl F. Eklund, Colonel  
Corps of Engineers  
Deputy Division Engineer  
424 Trapelo Road  
Waltham 54, Massachusetts

File No. NEDGW

Dear Sir:

Replying to your letter dated June 12, 1961, the Board of Selectmen feel that because of the possible danger in allowing public fishing from the proposed breakwater, that this idea be eliminated from the plans.

Yours very truly,

*Clarence E. Chapman*  
Clarence E. Chapman  
Clerk, Board of Selectmen

cec/ejm



OFFICE OF

## Board of Selectmen

ABBOT HALL

JAMES N. SKINNER, CHAIRMAN  
J. ARCHER DIXEY  
NORRIS W. HARRIS  
J. MILARY ROCKETT  
CHESTER M. SAWTELLE  
CLARENCE E. CHAPMAN, CLERK

MARBLEHEAD, MASS.

July 21, 1961

Karl F. Eklund  
Colonel, Corps of Engineers  
Deputy Division Engineer  
424 Trapelo Road  
Waltham 54, Massachusetts

Dear Sir:

We have received a copy of a letter to you from Charles L. McLaughlin, Director Division Fisheries and Game, Commonwealth of Massachusetts, dated July 19, 1961 in which he reiterates position that a proposed Marblehead breakwater should be so constructed as to facilitate use for fishing and recreation.

We wish to reiterate our position that we do not believe this to be desirable or necessary, that the parking space desired by the Division of Fisheries and Game in connection with the breakwater would not be available and that an attempt to use park land for automobile parking would very possibly defeat any article calling for a town appropriation at our Town Meeting.

Yours very truly,

*Clarence E. Chapman*  
Clarence E. Chapman  
Clerk, Board of Selectmen

jns/ejm  
cc: Charles L. McLaughlin, Dir.  
Div. Fisheries and Game

## MARBLEHEAD HARBOR, MASSACHUSETTS

Information Called for by Senate Resolution 148, 85th Congress,  
Adopted 28 January 1958

1. Navigation Problems. Marblehead Harbor is a small cove, located in Massachusetts Bay, about halfway between Cape Ann and Boston. The harbor has an area of about 300 acres with depths of 6 feet, 12 feet, and 18 feet at mean low water, available over areas 260, 200, and 160 acres, respectively. The harbor is used by recreational and fishing boats.

2. The principal difficulty attending navigation in the harbor is the unsafe anchorages. The harbor is exposed to storm waves from the northeast quadrant which results in swells that make unsafe anchorage, considerable boat damage, curtails the recreational boating season, and fishing operations.

3. Improvement Considered. In order to provide for sheltered anchorage in the harbor, local interests requested breakwater protection. The desired improvement considered most effective for the protection of the harbor was a breakwater 1500 feet long, extending magnetic north from Lighthouse Point on Marblehead Neck. Studies of the improvement proposed by the local interests were made and it was found not to be economically feasible. Therefore, an alternate plan of improvement was studied. This plan would provide nearly the same protection as the requested improvement at a much lower cost.

4. Recommended Improvement. To provide protected anchorage for the existing and prospective fleets in Marblehead Harbor, the alternate plan is recommended. The alternate plan is a stone breakwater 1200 feet long, extending northwesterly from Lighthouse Point on Marblehead Neck. The estimated first costs, annual costs, and annual benefits, based on July 1961 price levels, a 100-year project life and interest rates of 2-5/8 per cent on Federal funds and 3-1/2 per cent on non-Federal funds are as follows:

a. Estimated First Cost of Construction:

|   |                |     |
|---|----------------|-----|
| Federal                                       | \$1,752,000    | (1) |
| Non-Federal                                   | <u>648,000</u> | (2) |
| Total Estimated First Cost<br>of Construction | \$2,400,000    |     |

- (1) Excludes preauthorization study costs of \$9,000 and additional navigation aids of \$2,000.  
(2) Cash contribution of 27 per cent.

b. Estimated Annual Charges

|                                | <u>Federal</u> | <u>Non-Federal</u> | <u>Total</u> |
|--------------------------------|----------------|--------------------|--------------|
| Interest and Amortization      | \$50,010       | \$23,460           | \$73,470     |
| Maintenance - Project          | 7,500          | 0                  | 7,500        |
| Navigation Aids                | <u>130</u>     | <u>0</u>           | <u>130</u>   |
| Total Estimated Annual Charges | \$57,640       | \$23,460           | \$81,100     |

c. Estimated Annual Benefits

|                                 | <u>General</u> | <u>Local</u>  | <u>Total</u>  |
|---------------------------------|----------------|---------------|---------------|
| Commercial Fishing              | \$51,400       | 0             | \$51,400      |
| Recreational                    | 13,050         | \$13,050      | 26,100        |
| Storm Damage Fishing Boats      | 5,000          | 0             | 5,000         |
| Recreational Boats              | <u>20,000</u>  | <u>20,000</u> | <u>40,000</u> |
| Total Estimated Annual Benefits | \$89,450       | \$33,050      | \$122,500     |

d. Benefit-Cost Ratio = 1.5

5. Apportionment of Costs and Local Cooperation. In view of local benefits, local interests should be required to contribute in cash 27 per cent of the first cost of construction, said contribution presently estimated at \$648,000 (July 1961). In addition to this requirement, local interests should be required to:

a. Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction and maintenance of the project when and as required. Rights-of-way should include access to a contractor with his equipment to construct the breakwater from land.

b. Hold and save the United States free from damages that may result from construction and subsequent maintenance of the project.

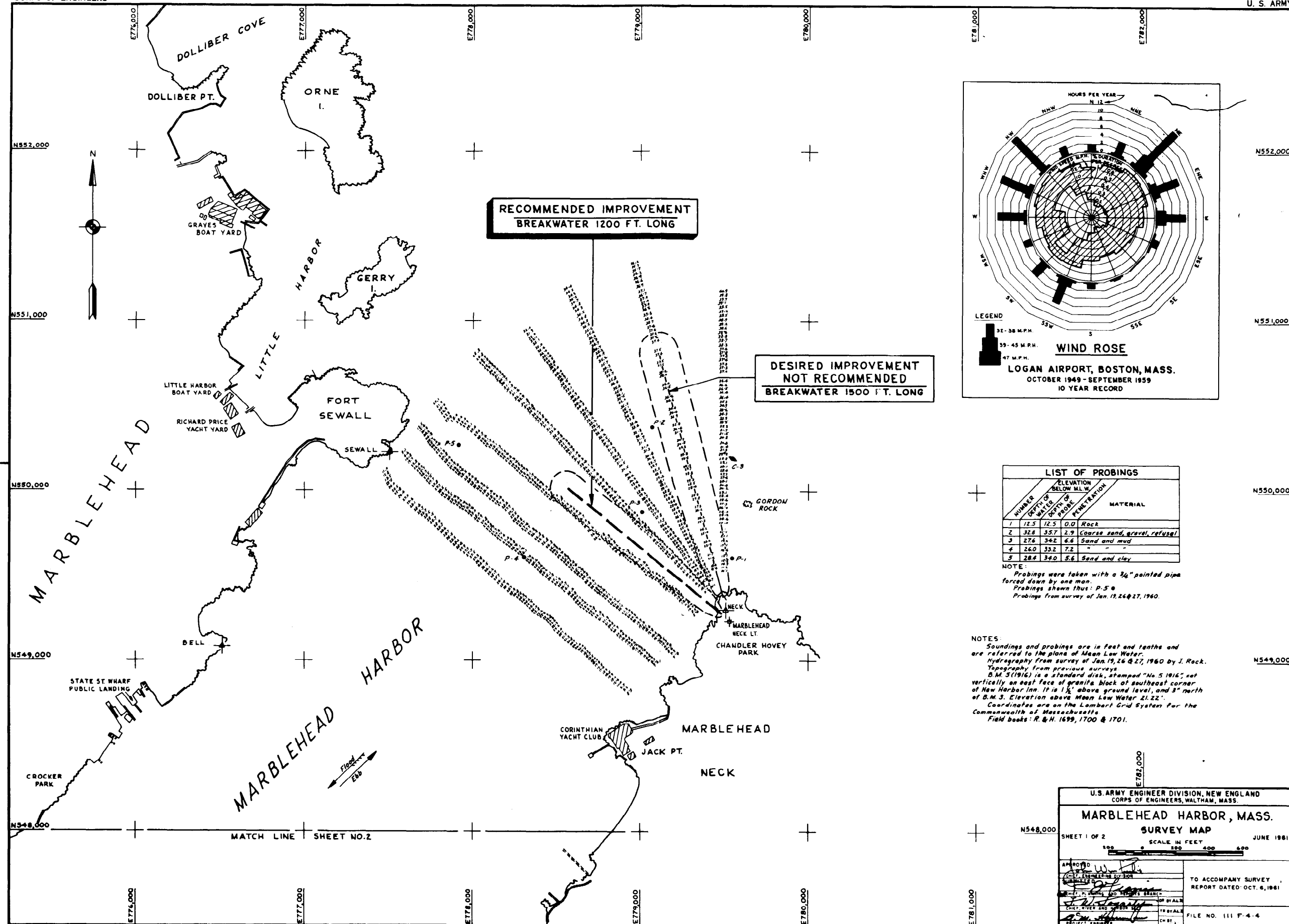
c. Provide assurances that the existing public landings or their equivalent will be adequately maintained during the life of the project and will be open to all on equal terms.

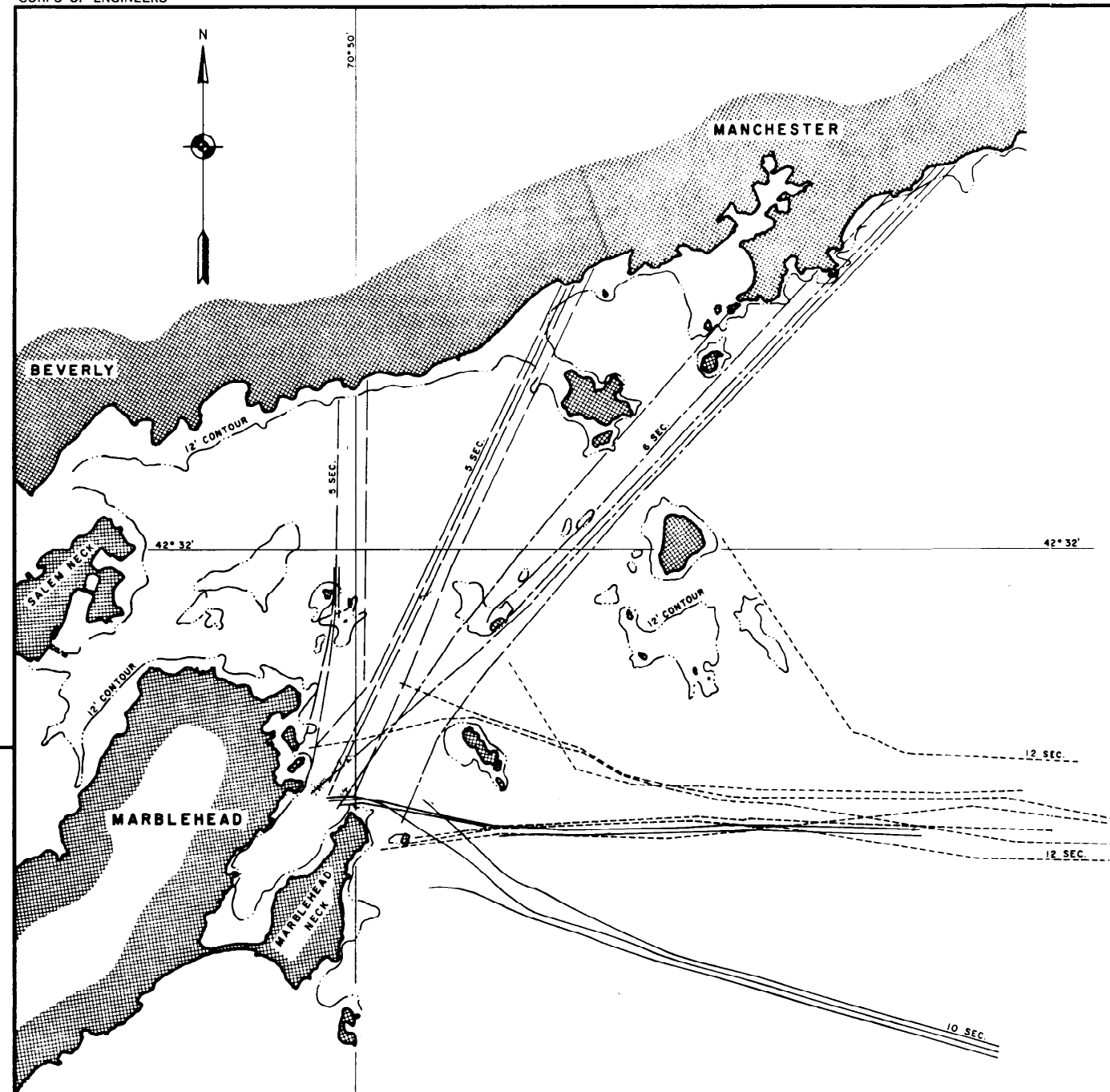
6. Discussion. Local interests have approved the recommended plan and have indicated that the requirements of local cooperation would be met. The recommended improvement would provide a logical and economically feasible means of meeting current and prospective



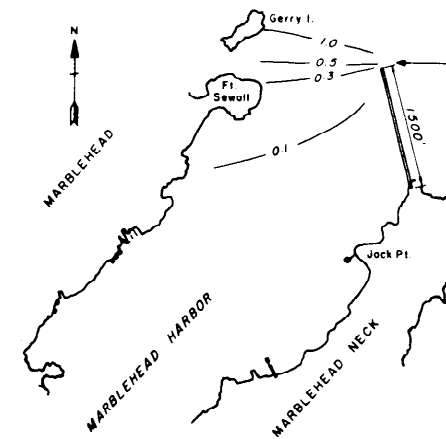
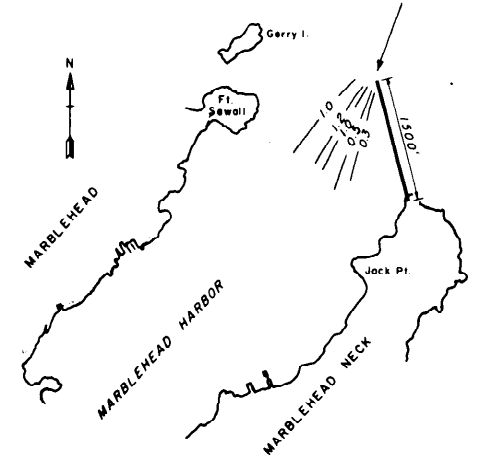
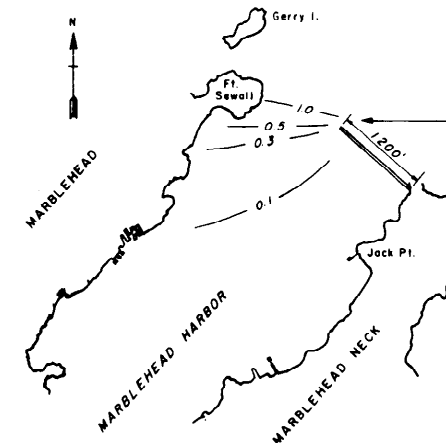
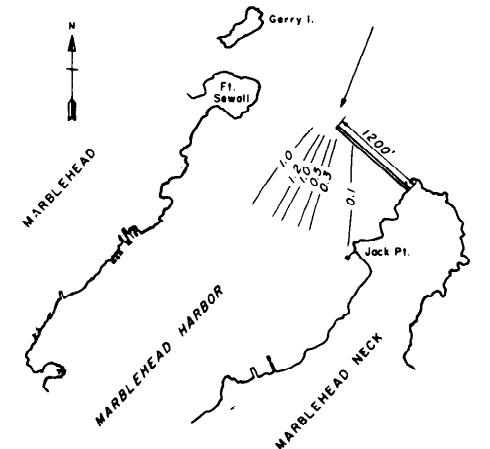
needs of navigation in the harbor. Analysis on the basis of an economic life of 100 years would result in a benefit-cost ratio of 1.5. The project is considered justified on the basis of studies and criteria in the report. Proposed local cooperation is consistent with other similar projects.







REFRACTION DIAGRAM

SCALE IN FEET  
2000 0 2000 4000 6000LONG PERIOD WAVE FROM THE EAST  
WAVE LENGTH - 290 FEETSHORT PERIOD WAVE FROM NNE  
5 SEC. WAVE - LENGTH 128 FEETLONG PERIOD WAVE FROM THE EAST  
WAVE LENGTH - 290 FEETSHORT PERIOD WAVE FROM NNE  
5 SEC. WAVE - LENGTH 128 FEET

DIFFRACTION DIAGRAMS

SCALE IN FEET  
1000 0 1000 2000 3000

|   |   |
|---|---|
| U.S. ARMY ENGINEER DIVISION, NEW ENGLAND<br>CORPS OF ENGINEERS, WALTHAM, MASS.                              |   |
| <b>MARBLEHEAD HARBOR<br/>MASSACHUSETTS<br/>WAVE DIAGRAMS</b>  |   |
| SHEET 1 OF 1  | JUNE 1961   |
| APPROVED<br><i>[Signature]</i><br>SUBMITTED<br><i>[Signature]</i><br>PROJECT ENGINEER<br><i>[Signature]</i> | TO ACCOMPANY SURVEY<br>REPORT DATED: OCT. 6, 1961<br>FILE NO. 113 F-4-4 |